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ENGINEERING • SYSTEMS ANALYSIS • ENVIRONMENTAL SYSTEMS • SUPPORT SERVICES

OAO/TR-81/0033

LANDSAT-D THERMAL ANALYSIS
AND
DESIGN SUPPORT

Prepared for
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

In Response to
Contract NAS5-25737, Modification 5

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CONTENTS

SECTION 1. INTRODUCTION

This report presents a summary of the results of the tasks done under NASA Goddard Spaceflight Center (GSFC) contract NAS5-25737, Mod 5. The objectives of this contract were to develop detailed thermal models of the Landsat-D Earth Sensor Assembly Module (ESAM), the Dummy Thematic Mapper (DTM), and a small thermal model of the Landsat-D spacecraft for a heater analysis. These models were used to develop and verify the thermal design of the ESAM and DTM, to evaluate the aeroheating effects on ESAM during launch and to evaluate the thermal response of the Landsat-D assuming the hard-line heaters failed on with the spacecraft in the Space Transportation System (STS) orbiter bay. An additional request was made to predict ESAM temperatures for the thermal balance test conditions.

The analyses required to meet these objectives were independent tasks, each with a separately written report describing the results. In addition, several of the tasks were subdivided into distinct phases. Separate reports were issued for each phase. For example, the ESAM task write-ups include the model development in one report, a discussion of the orbital predictions using that model in another, and a discussion of various design modifications and their effects in a third report. These reports were issued as internal OAO Corporation technical memoranda, copies of which were given to the GSFC technical officer for information. Section 2 of this report summarizes the results of each of the tasks performed under this contract. The originally issued memoranda are included in the appendices.

SECTION 2. SUMMARY OF RESULTS

2.1 THERMAL ANALYSIS OF THE ESAM

The objectives of the task were to produce a detailed thermal model of the ESAM and use this model to evaluate its thermal design and structural gradients.

These goals were achieved by examining the ESAM's sensitivity to various operational conditions. These were the spacecraft orbit, the Multimission Modular Spacecraft (MMS) interface temperature, the ESAM supply voltage, and the number of sensors turned on. Combinations of these conditions were run for both steady state and transient cases to predict the temperature response of the ESAM. From these computer runs, the temperature ranges for the possible operational modes were found and, from these, the sensitivities.

The thermal model used for this study is discussed in detail in Appendix A. It basically is a 60-node model which is sufficiently detailed to enable the evaluation of any ESAM temperature gradients. This model was set up in the Simplified Shuttle Payload Thermal Analyzer (SSPTA) computer program format. SSPTA was used since fluxes, view factors, and nodal temperatures could be calculated without having to use other programs.

These analyses indicate that the ESAM thermal design is adequate to maintain the ESAM within the normal operational limits of -10^{o}C to 35^{o}C using passive thermal control. The normal operational steady state temperature for the structure was predicted to range from 8.6^{o}C to 18.2^{o}C with a nominal temperature of about 13^{o}C. With the ESAM sensors off and the heaters disabled the structural temperature stabilizes at -11.8^{o}C, just below the lower temperature limit. The only case which exceeded the upper temperature limit was a heater and sensor on case for which a steady state structural temperature of 42.6^{o}C was predicted. This case is unlikely to occur in flight since it requires both proportional heaters systems to fail on at full power, and both sensors to continue to operate.

The ESAM thermal design sensitivities to the various operational parameters were also determined in these analyses. These sensitivities were found by evaluating the steady state temperature variations for ESAM over the maximum range of each of the operational parameters. The parameters of interest were the orbit variation, MMS temperature variation, and supply voltage variation. The resulting ESAM temperature sensitivities are: a $1^{o}C$ change over the range of flux conditions, $0.3^{o}C$ change for a $1^{o}C$ change in the MMS temperature, and $0.4^{o}C$ change for a 1V change in the supply voltage. Details of these analyses of the ESAM design are presented in Appendix B.

2.2 ESAM THERMAL VARIATIONS RESULTING FROM DESIGN VARIATIONS

At the request of the Landsat-D thermal engineer, analyses were done to examine the effects of several variations from the baseline design used in the thermal analysis of the ESAM. These variations were discovered during the inspection of the prototype ESAM prior to construction of the multilayer insulation (MLI) blankets and coating of the radiator surfaces. It was found that silver teflon could not easily be attached to the edges of the bracket radiators because of the rolled surfaces, and it was suggested that these radiators be painted white instead. The central electronics box radiator plate is attached to the frame by 20 exposed bolts, which change the effective radiating area of this plate. Finally, the design of the ESAM does not permit the MLI to be mounted flush to the sides of ESAM, thus leaving a gap between the outer surfaces of the ESAM and the inner surfaces of the MLI around the perimeter of the radiators.

A parametric study of the effect of each of these factors on the ESAM temperature was made on a reduced model. This one node ESAM model included the radiative couplings to space for the radiators, sensors, and insulation, and the absorbed fluxes, sensor and electronics powers, and the heat conducted from MMS. This reduced model, without any modifications for the design variations, predicts steady state temperatures within $1^{o}C$ of the detailed model predictions for the ESAM structure. The modifications for the design variations were accounted for by varying the absorbed fluxes and radiative coupling to space accordingly.

The analyses indicate the following ESAM temperature trends. The white paint on the bracket radiators, which replaces the original silver teflon, decreased the ESAM temperature by $1^{\circ}C$. This occurs as a result of the greater effect due to the increase in the radiation coupling to space as compared to the effect of the increase in absorbed fluxes. The 20 mounting bolts, which are stainless steel and assumed to have an α/ϵ ratio of 0.45/0.15, increased the ESAM temperature by $1^{\circ}C$. This increase is a result of the larger effect of the decrease in the radiation coupling to space as compared to the effect of the decrease in absorbed fluxes. The gap between the MLI and ESAM sides, assumed to be a 0.25 inch wide black aperture, decreased the ESAM temperature by $1^{\circ}C$. This again is a result of the larger effect of the increase in the radiation coupling to space as compared to the effect of the increase in absorbed fluxes.

Including all these variations, the updated design with white paint on the bracket radiators reduced the temperature of the ESAM about $1^{\circ}C$ from the baseline design. Another $0.5^{\circ}C$ drop can be achieved by painting the exposed bolt heads and washers white to improve their heat rejection capabilities.

2.3 ESAM THERMAL BALANCE TEST PREDICTIONS

A prototype unit of the ESAM structure was built at GSFC for testing purposes. A thermal balance test was performed using this prototype structure and thermal mock-ups of the Earth Sensor Electronics (ESE) and Scanners (ESS). At the request of the Landsat thermal engineer, OAO modified the ESAM analytical model to represent the test configuration and made temperature predictions for two of the test cases. The details of this effort and the results are discussed in Appendix C.

2.4 ESAM AEROHEATING ANALYSIS

The purpose of this stu s to ascertain the magnitude and direction of the temperature variation of the ESAM from the time of launch on the Delta vehicle until orbital insertion of the spacecraft. This analysis was

broken into three separate stages to correspond to the three phases of the flight. These are as follows:

1. Initial ascent of the vehicle with the fairing on (T=0 through T + 4 minutes)

2. Aeroheating of the spacecraft after fairing jettison (T + 4 through T + 23 minutes)

3. Coast Trajectory until final orbital insertion (T + 23 through T + 74 minutes)

A single node model was used to represent the ESAM structure, sensors, radiators, and electronics. This assumption of a single node was developed after reviewing the results of the thermal analysis done on the 60-node model described in Appendices A and B. That study indicated that the predominant heat input and rejection was through the radiators on the +Z surface, and that no significant temperature gradients existed within the ESAM. The only other minor heat input was by conduction through the MMS interface, but since the MMS would probably be at the same temperature as ESAM during the launch phases, there would be little, if any, heat exchange by conduction. Consequently, the ESAM single node model had only a radiation coupling to space, equal to that of the radiators to space, and a thermal inertia equal to the sum of the inertias of its components.

The resulting temperature profile for this mission scenario indicates that the ESAM temperature will rise from its initial temperature of 21°C to 21.5°C in phase 1, rise from 21.5°C to 22°C in phase 2, and fall from 22°C to 16.5°C in phase 3.

Appendix D contains the details of this analysis.

2.5 THERMAL ANALYSIS OF THE DTM

The objectives of the task were to produce a detailed thermal model of the DTM and use this model to evaluate its thermal design and structural gradients. This analysis examined the DTM's sensitivity to the spacecraft orbit, the MMS interface temperature, the insulation effectiveness, and heater power levels.

The thermal model used for his study is discussed in detail in Appendix E. Basically, it is a 105 node model with a concentration of nodes for the interior portion of the DTM main frame to yield detailed structural gradient information. This is of importance since the attitude determination sensor assembly (ADSA), the heaters and thermostats, and the mounting feet to the Landsat instrument model (I/M) are all in that area. This model was set up in the SSPTA computer program format.

These analyses indicate that the DTM thermal design is adequate to maintain the DTM at the normal operating temperature of 15°C with 34 watts of heater power, the I/M temperature at 10°C, and an insulation effectiveness of 0.02. The steady state structural gradients average 1.5°C across the main frame.

The DTM thermal design sensitivities to the various operational parameters were also determined. The parameters of interest were the orbit variation, MMS interface temperature, insulation effectiveness, and heater power level. These sensitivities in the DTM state temperatures are: a 1.3°C change over the range of flux conditions, 0.4°C change for a 1°C change in the MMS temperature, 0.[illegible]°C change for a 1W change in heater power, and a 10°C change for an insulation effectiveness change from 0.02 to 0.01.

Further details are presented in Appendix F.

2.6 LANDSAT-D HARDLINE HEATERS ANALYSIS

This study was conducted to determine the transient temperature response of the major Landsat-D Spacecraft components if all of the hardline heaters failed on while it is in the orbiter bay. In addition to the temperature profiles, two other items of interest were determined. They were the time for each component to reach the maximum safe retrieval temperature and the component temperature rate of change at the time the limit temperature was reached.

The model used in this analysis was developed from several other thermal models. They are the MMS model previously generated for the MMS Project Office and the Landsat-D models developed by A.D. Little, Inc. and General

Electric (GE). The MMS model component radiation couplings, conduction couplings, and thermal inertias were used directly in this model. The only modifications made were to change the radiation couplings from space to an STS/EARTH boundary. The Landsat-D thermal inertias were taken from the GE model. The radiation couplings to space for the insulated surfaces were scaled by the effective emittance of the insulation blanket to approximate the radiation transfer between an internal node and a boundary node without having to explicitly solve for the external temperature of the blanket. These couplings were then coupled to the STS/EARTH boundary.

Using this reduced model, the component temperature profiles were found by applying the appropriate boundary temperatures, initial component temperatures, and component heater power conditions. The conditions were as follows. The boundary to which the surface nodes radiated was assumed to be a black cavity at -5^{o}C. This temperature corresponds to the steady state value for the orbiter in an earth viewing attitude. The initial component temperatures were assumed to be 20^{o}C. The component heater powers were those for a nominal supply voltage of 28V and were assumed constant throughout the analysis.

See Appendix G for the complete tabular listing of the results.

APPENDIX A. ESAM DETAILED THERMAL MODEL

MEMORANDUM

LDTHER-IOM-81-001
May 20, 1981

OAO CORPORATION

TO : Dave Mengers

FROM : Doan Eiband

SUBJECT: Landsat-D Earth Sensor Assembly Detailed Thermal Model

The purpose of this task was to produce a detailed thermal model of the Landsat-D Earth Sensor Assembly Module (ESAM) with sufficient definition to enable evaluation of module thermal gradients and verification of the overall thermal design.

In general, the ESAM is composed of three distinct elements A central box which houses the two sensor electronics packages and joins the ESAM to the multi-mission modular spacecraft (MMS) and two brackets which align the two sensors and connect them to the central box. These brackets are mounted to the outer +Y and -Y faces of the central box. The electronics packages are mounted to the inner +Y and -Y faces of the central box. (The coordinate system referenced here is identical to the Landsat axes with the +Z axis facing the Earth, the +X axis facing in the direction of orbital velocity, and the +Y axis completing the Cartesian system). This essentially gives the ESAM axial symmetry about the Z-axis, although the brackets are slightly different.

For the central box, the -Z surface is a multi-layer insulation (MLI) blanket which closes the box, while the +Z surface is a radiator. The +Y and -Y surfaces are the mounting surfaces for the sensor brackets and the heat conduction paths from the two electronics packages to the radiator. On the +X surface is a radiation shield over the ESAM wiring harness. This shield is assumed to be an aluminum box three inches in depth, open on the -Z and -X faces to allow the wires to pass through and with the remaining surfaces insulated. The -X surface is a MLI insulation blanket which closes the box.

The two sensor brackets are similar in construction to each other, the major difference being the sensor mounting surfaces which are canted differently to allow viewing in different directions. Consequently, both brackets will be described together. The brackets are insulated on all sides including the open -Z faces. The only surfaces not insulated are the +Z ones which are the radiators and those which are connected to the central box. The sensors protrude through the mounting surfaces and MLI and are uninsulated.

The ESAM is located in a vee formed by two units of the MMS, the Command and Data Handling unit (C&DH) and the Modular Power Supply unit (MPS). Also located in this vee is the Signal Conditioning and Control unit (SC&CU) which is located slightly above (+X direction) the radiation shield of the ESAM. These MMS surfaces and SC&CU surfaces comprise the external boundaries which affect the radiation heat exchange from the ESAM. This configuration is shown in Figure 1.

The ESAM surface model used to generate the radiation couplings was constructed using two separate surface models: an external surface model of the ESAM and its boundaries, and an internal surface model of the ESAM. These two models were run using the simplified shuttle payload thermal analyzer computer program (SSPTA) to give the couplings between the external nodes and the couplings between the internal nodes. The remaining radiation couplings for the heat transfer through the insulation blankets and between the outer surfaces of the central box and the brackets were calculated by hand. An effective emittance of 0.02 was assumed through the MLI for those calculations. The bracket to box coupling assumed an exchange between two infinite parallel black plates.

The external surface model was composed of the outer ESAM surfaces and the MMS surfaces. The insulated ESAM bracket and box outer surfaces are 3 mil aluminized kapton with the kapton facing out. The ESAM radiators, MMS surfaces, and SC&CU surfaces are coated with silver teflon. The ESAM sensor surfaces which extend through the MLI are painted white with the exception of the lens and its retaining ring which are assumed to be quartz and bare titanium, respectively. It was later discovered that the lenses were germanium, not quartz, as had been assumed. The analyses were made using the quartz properties, however, a single steady state temperature computer run was made using germanium properties to assess the effects of this change. The results of this comparison will be presented in a memorandum discussing the ESAM analyses.

The internal ESAM surface model was composed of the electronics packages surfaces, the central box surfaces, bracket surfaces, and radiator inner surfaces. All of the interior surfaces except the sensor surfaces are painted black to enhance the radiation transfer to the radiators. The sensor barrel is painted white while the electrical interface is bare titanium. A summary of the internal model properties and those of the external model by node is given in Table 1.

The conduction couplings for the model were calculated for each internal node pair by hand. These couplings took in to account the bolt conduction through the four mounting bolts for each electronics package to the central box wall, as well as the bolt conduction and surface resistance for mounting the brackets to the central box. Also considered were the rivet conduction and contact resistance for each of the rolled surface joints used in the brackets and central box construction.

The interface conductance between the ESAM and the MMS was assumed to be 0.215 watts/^{o}C, a value calculated by Mr. Al Seivold of GSFC for the proposed interface design.

The thermal inertias were found by calculating the MCp value per unit area for the various materials and surface thicknesses used in the ESAM. Each of the surface areas was then multiplied by the appropriate MCp per unit area to find the thermal inertias of the surfaces. These surface MCp values were finally added together to achieve the inertias on a nodal basis.

The result of this modeling effort was a 60-node model of the ESAM and its surroundings for the Landsat-D configuration. This model was subsequently used for ESAM design verification and flight predictions. The model couplings are given in Appendix A.

Doan Eiband

Doan Eiband

Attachment

/baa

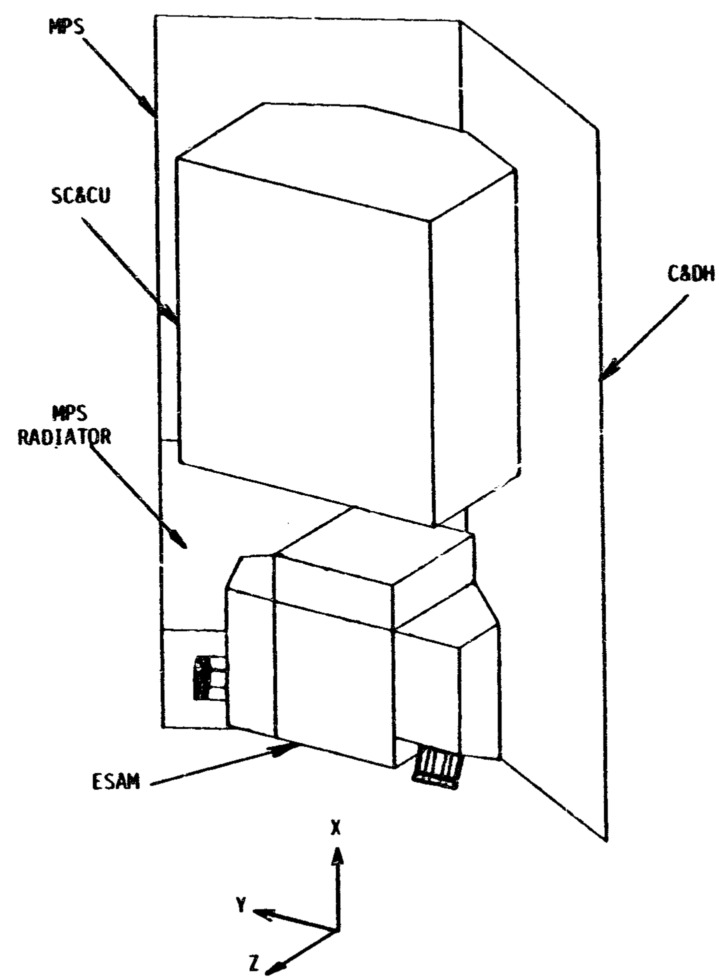

Figure 1. Landsat-D Earth Sensor Assembly Detailed Thermal Model Configuration

Table 1. ESAM Nodal Properties

NODE	DESCRIPTION	α/ε
	EXTERNAL PROPERTIES	
1	RADIATION SHIELD (+X surface)	0.45/0.80
2-5	+Y BRACKET	0.45/0.80
6	-X SURFACE	0.45/0.80
7-10	-Y BRACKET	0.45/0.80
11-16	RADIATORS (+Z surface)	0.12/0.76
17	-Z SURFACE	0.45/0.80
18	MMS SURFACE	0.12/0.76
19	MPS RADIATOR	0.12/0.76
20	+Y SENSOR (barrel)	0.20/0.91
21	+Y SENSOR (lens ring)	0.45/0.15
22	+Y SENSOR (lens)	0.92*/0.88 (quartz)
23	-Y SENSOR (barrel)	0.20/0.91
24	-Y SENSOR (lens ring)	0.45/0.15
25	-Y SENSOR (lens)	0.92*/0.88 (quartz)

* includes UV transmission $\tau = .9$
(for germanium $\alpha/\varepsilon = .3/.7$ with IR transmission $\tau = .2$)

INTERNAL PROPERTIES

30	RADIATION SHIELD (+X surface)	0.95/0.86
31-32	+Y BRACKET (MLI)	0.38/0.61
33-39	+Y BRACKET	0.95/0.86
40	-X SURFACE (MLI)	0.38/0.61
41-42	-Y BRACKET (MLI)	0.38/0.61

NODE	DESCRIPTION	α/ϵ
43-50	-Y BRACKET	0.95/0.86
51	-Z SURFACE (MLI)	0.38/0.61
52	+Y ELECTRONICS BOX	0.95/0.86
53-54	+Y ELECTRONICS BOX WALLS	0.95/0.86
55	-Y ELECTRONICS BOX	0.95/0.86
56-57	-Y ELECTRONICS BOX WALLS	0.95/0.86
58	+Y SENSOR (barrel)	0.20/0.91
59	+Y SENSOR (electrical interface)	0.45/0.15
60	-Y SENSOR (barrel)	0.20/0.91
61	-Y SENSOR (electrical interface)	0.45/0.15
62	+Y ELECTRONICS BOX BASE PLATE	0.95/0.86
65	-Y ELECTRONICS BOX BASE PLATE	0.95/0.86
80	MMS INTERFACE (boundary node)	-
100	SPACE NODE	-

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EXTERNAL ESAM ASF

RAD	0000	2.670	1	2	0	0	0	0
GENERATED NODE		1						
GENERATED NODE		2						
RAD	0000	0.306	1	3	0	0	0	0
GENERATED NODE		3						
RAD	0000	36.391	1	4	0	0	0	0
GENERATED NODE		4						
RAD	0000	0.106	1	5	0	0	0	0
GENERATED NODE		5						
RAD	0000	0.378	1	6	0	0	0	0
GENERATED NODE		6						
RAD	0000	1.810	1	7	0	0	0	0
GENERATED NODE		7						
RAD	0000	0.397	1	8	0	0	0	0
GENERATED NODE		8						
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GENERATED NODE		9						
RAD	0000	36.121	1	10	0	0	0	0
GENERATED NODE		10						
RAD	0000	0.011	1	12	0	0	0	0
GENERATED NODE		12						
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GENERATED NODE		13						
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GENERATED NODE		14						
RAD	0000	0.030	1	16	0	0	0	0
GENERATED NODE		16						
RAD	0000	2.933	1	17	0	0	0	0
GENERATED NODE		17						
RAD	0000	512.951	1	18	0	0	0	0
GENERATED NODE		18						
RAD	0000	43.308	1	19	0	0	0	0
GENERATED NODE		19						
RAD	0000	0.159	1	20	0	0	0	0
GENERATED NODE		20						
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GENERATED NODE		22						
RAD	0000	0.071	1	23	0	0	0	0
GENERATED NODE		23						
RAD	0001	287.269	1	100	0	0	0	0
GENERATED NODE		100						
RAD	0000	1.249	2	3	0	0	0	0
RAD	0000	0.278	2	4	0	0	0	0
RAD	0000	0.389	2	5	0	0	0	0
RAD	0000	0.491	2	6	0	0	0	0
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RAD	0000	0.037	2	9	0	0	0	0
RAD	0000	0.052	2	10	0	0	0	0
RAD	0000	8.121	2	17	0	0	0	0
RAD	0000	38.464	2	18	0	0	0	0
RAD	0000	218.297	2	19	0	0	0	0
RAD	0000	0.527	2	20	0	0	0	0
RAD	0000	0.027	2	21	0	0	0	0
GENERATED NODE		21						
RAD	0000	0.085	2	22	0	0	0	0
RAD	0000	0.033	2	23	0	0	0	0
RAD	0001	56.750	2	100	0	0	0	0
RAD	0000	0.039	3	4	0	0	0	0
RAD	0000	0.053	3	5	0	0	0	0

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RAD	0000	0.014	5	10	0	0	0	0
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GENERATED NODE		25						
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GENERATED NODE		11						
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RAD	0001	79.402	11	100	0	0	0	0
RAD	0000	0.124	12	18	0	0	0	0
RAD	0001	81.119	12	100	0	0	0	0
RAD	0000	0.176	13	18	0	0	0	0
RAD	0001	194.118	13	100	0	0	0	0
RAD	0000	0.138	14	18	0	0	0	0
RAD	0001	88.170	14	100	0	0	0	0
RAD	0000	0.080	15	18	0	0	0	0
GENERATED NODE		15						
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RAD	0000	0.336	16	18	0	0	0	0
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RAD	0000	137.838	17	19	0	0	0	0
RAD	0000	0.337	17	20	0	0	0	0
RAD	0000	0.017	17	21	0	0	0	0
RAD	0000	0.054	17	22	0	0	0	0
RAD	0000	0.112	17	23	0	0	0	0
RAD	0001	49.354	17	100	0	0	0	0
RAD	0000	163.235	18	19	0	0	0	0
RAD	0000	4.866	18	20	0	0	0	0
RAD	0000	0.264	18	21	0	0	0	0
RAD	0000	0.466	18	22	0	0	0	0
RAD	0000	10.335	18	23	0	0	0	0
RAD	0000	0.552	18	24	0	0	0	0
RAD	0000	0.818	18	25	0	0	0	0
RAD	0001	7509.147	18	100	0	0	0	0
RAD	0000	8.780	19	20	0	0	0	0
RAD	0000	0.446	19	21	0	0	0	0
RAD	0000	1.430	19	22	0	0	0	0
RAD	0000	0.407	19	23	0	0	0	0
RAD	0000	0.036	19	24	0	0	0	0
RAD	0001	504.954	19	100	0	0	0	0
RAD	0001	46.217	20	100	0	0	0	0
RAD	0001	2.265	21	100	0	0	0	0
RAD	0001	29.418	22	100	0	0	0	0
RAD	0001	45.436	23	100	0	0	0	0
RAD	0001	2.292	24	100	0	0	0	0
RAD	0001	30.541	25	100	0	0	0	0
NODE	0101	100	1.000	0.000				

100 NODE PREVIOUSLY DEFINED OVERIDES PREVIOUS INPUT.

```
INTERNAL ESAM ASF
RAD     0000     4 719       11       31      0      0      0      0
GENERATED NODE      31
RAD     0000     6 785       11       33      0      0      0      0
GENERATED NODE      33
RAD     0000    17 504       11       36      0      0      0      0
GENERATED NODE      36
RAD     0000    22 104       11       37      0      0      0      0
GENERATED NODE      37
RAD     0000    17 504       11       39      0      0      0      0
GENERATED NODE      39
RAD     0000    19 068       11       58      0      0      0      0
GENERATED NODE      58
RAD     0000     0 134       11       59      0      0      0      0
GENERATED NODE      59
RAD     0000    10 600       12       32      0      0      0      0
GENERATED NODE      32
RAD     0000    12 009       12       34      0      0      0      0
GENERATED NODE      34
RAD     0000    21 189       12       35      0      0      0      0
GENERATED NODE      35
RAD     0000    25 255       12       38      0      0      0      0
GENERATED NODE      38
RAD     0000    21 189       12       39      0      0      0      0
RAD     0000     1 406       13       16      0      0      0      0
RAD     0000    23 053       13       30      0      0      0      0
GENERATED NODE      30
RAD     0000    15 279       13       40      0      0      0      0
GENERATED NODE      40
RAD     0000     5 143       13       51      0      0      0      0
GENERATED NODE      51
RAD     0000    14 561       13       52      0      0      0      0
GENERATED NODE      52
RAD     0000     9 864       13       53      0      0      0      0
GENERATED NODE      53
RAD     0000    10 380       13       54      0      0      0      0
GENERATED NODE      54
RAD     0000    26 663       13       55      0      0      0      0
GENERATED NODE      55
RAD     0000     0 957       13       56      0      0      0      0
GENERATED NODE      56
RAD     0000     1 730       13       57      0      0      0      0
GENERATED NODE      57
RAD     0000     8 553       14       41      0      0      0      0
GENERATED NODE      41
RAD     0000    16 069       14       43      0      0      0      0
GENERATED NODE      43
RAD     0000    25 991       14       45      0      0      0      0
GENERATED NODE      45
RAD     0000    25 991       14       48      0      0      0      0
GENERATED NODE      48
RAD     0000    21 176       14       49      0      0      0      0
GENERATED NODE      49
RAD     0000     6 297       15       42      0      0      0      0
GENERATED NODE      42
RAD     0000    15 621       15       44      0      0      0      0
GENERATED NODE      44
RAD     0000     1 371       15       46      0      0      0      0
GENERATED NODE      46
RAD     0000     8 252       15       47      0      0      0      0
GENERATED NODE      47
```

RAD	0000	23.603	15	48	0	0	0	0
RAD	0000	19.359	15	50	0	0	0	0
GENERATED NODE		50						
RAD	0000	20.029	1[illegible]	60	0	0	0	0
GENERATED NODE		60						
RAD	0000	0.144	15	61	0	0	0	0
GENERATED NODE		61						
RAD	0000	23.055	16	30	0	0	0	0
RAD	0000	15.279	16	40	0	0	0	0
RAD	0000	5.143	16	51	0	0	0	0
RAD	0000	26.661	16	52	0	0	0	0
RAD	0000	1.068	16	53	0	0	0	0
RAD	0000	1.620	16	54	0	0	0	0
RAD	0000	114.557	16	55	0	0	0	0
RAD	0000	7.891	16	56	0	0	0	0
RAD	0000	12.352	16	57	0	0	0	0
RAD	0000	10.685	30	40	0	0	0	0
RAD	0000	38.172	30	51	0	0	0	0
RAD	0000	147.445	30	52	0	0	0	0
RAD	0000	27.295	30	53	0	0	0	0
RAD	0000	2.382	30	54	0	0	0	0
RAD	0000	147.627	30	55	0	0	0	0
RAD	0000	26.653	30	56	0	0	0	0
RAD	0000	3.061	30	57	0	0	0	0
RAD	0000	9.916	31	33	0	0	0	0
RAD	0000	26.035	31	36	0	0	0	0
RAD	0000	47.319	31	37	0	0	0	0
RAD	0000	26.035	31	39	0	0	0	0
RAD	0000	11.077	31	58	0	0	0	0
RAD	0000	0.358	31	59	0	0	0	0
RAD	0000	13.740	32	34	0	0	0	0
RAD	0000	27.234	32	35	0	0	0	0
RAD	0000	49.427	32	38	0	0	0	0
RAD	0000	27.234	32	39	0	0	0	0
RAD	0000	19.586	33	36	0	0	0	0
RAD	0000	17.924	33	37	0	0	0	0
RAD	0000	19.586	33	39	0	0	0	0
RAD	0000	17.806	33	58	0	0	0	0
RAD	0000	0.072	33	59	0	0	0	0
RAD	0000	30.037	34	35	0	0	0	0
RAD	0000	36.866	34	38	0	0	0	0
RAD	0000	30.037	34	39	0	0	0	0
RAD	0000	52.047	35	38	0	0	0	0
RAD	0000	48.4[illegible]0	35	39	0	0	0	0
RAD	0000	51.230	36	37	0	0	0	0
RAD	0000	35.937	36	39	0	0	0	0
RAD	0000	27.260	36	58	0	0	0	0
RAD	0000	0.876	36	59	0	0	0	0
RAD	0000	51.230	37	39	0	0	0	0
RAD	0000	10.533	37	58	0	0	0	0
RAD	0000	2.972	37	59	0	0	0	0
RAD	0000	52.049	38	39	0	0	0	0
RAD	0000	27.260	39	58	0	0	0	0
RAD	0000	0.876	39	59	0	0	0	0
RAD	0000	25.687	40	51	0	0	0	0
RAD	0000	95.876	40	52	0	0	0	0
RAD	0000	1.410	40	53	0	0	0	0
RAD	0000	19.449	40	54	0	0	0	0
RAD	0000	95.855	40	55	0	0	0	0
RAD	0000	1.033	40	56	0	0	0	0
RAD	0000	19.795	40	57	0	0	0	0

RAD	0000	4.510	41	43	0	0	0	0
RAD	0000	22.696	41	45	0	0	0	0
RAD	0000	22.696	41	48	0	0	0	0
RAD	0000	35.929	41	49	0	0	0	0
RAD	0000	6.902	42	44	0	0	0	0
RAD	0000	15.239	42	46	0	0	0	0
RAD	0000	14.283	42	47	0	0	0	0
RAD	0000	27.901	42	48	0	0	0	0
RAD	0000	61.296	42	50	0	0	0	0
RAD	0000	10.384	42	60	0	0	0	0
RAD	0000	0.609	42	61	0	0	0	0
RAD	0000	23.903	43	45	0	0	0	0
RAD	0000	23.903	43	48	0	0	0	0
RAD	0000	19.868	43	49	0	0	0	0
RAD	0000	4.027	44	46	0	0	0	0
RAD	0000	16.237	44	47	0	0	0	0
RAD	0000	25.733	44	48	0	0	0	0
RAD	0000	19.628	44	50	0	0	0	0
RAD	0000	20.681	44	60	0	0	0	0
RAD	0000	0.472	44	61	0	0	0	0
RAD	0000	61.662	45	48	0	0	0	0
RAD	0000	46.580	45	49	0	0	0	0
RAD	0000	2.444	46	47	0	0	0	0
RAD	0000	11.981	46	48	0	0	0	0
RAD	0000	22.204	46	50	0	0	0	0
RAD	0000	5.153	46	60	0	0	0	0
RAD	0000	0.074	46	61	0	0	0	0
RAD	0000	17.859	47	48	0	0	0	0
RAD	0000	25.535	47	50	0	0	0	0
RAD	0000	19.432	47	60	0	0	0	0
RAD	0000	0.095	47	61	0	0	0	0
RAD	0000	46.580	48	49	0	0	0	0
RAD	0000	53.259	48	50	0	0	0	0
RAD	0000	9.164	48	60	0	0	0	0
RAD	0000	2.980	48	61	0	0	0	0
RAD	0000	28.343	50	60	0	0	0	0
RAD	0000	0.912	50	61	0	0	0	0
RAD	0000	91.286	51	52	0	0	0	0
RAD	0000	10.723	51	53	0	0	0	0
RAD	0000	11.490	51	54	0	0	0	0
RAD	0000	91.281	51	55	0	0	0	0
RAD	0000	8.465	51	56	0	0	0	0
RAD	0000	13.748	51	57	0	0	0	0
RAD	0000	32.425	52	53	0	0	0	0
RAD	0000	35.657	52	54	0	0	0	0
RAD	0000	174.907	52	55	0	0	0	0
RAD	0000	4.355	52	56	0	0	0	0
RAD	0000	9.028	52	57	0	0	0	0
RAD	0000	0.396	53	54	0	0	0	0
RAD	0000	5.184	53	55	0	0	0	0
RAD	0000	2.313	53	56	0	0	0	0
RAD	0000	1.144	53	57	0	0	0	0
RAD	0000	8.202	54	55	0	0	0	0
RAD	0000	0.667	54	56	0	0	0	0
RAD	0000	3.664	54	57	0	0	0	0
RAD	0000	27.660	55	56	0	0	0	0
RAD	0000	40.421	55	57	0	0	0	0
RAD	0000	0.371	56	57	0	0	0	0
RAD	0000	0.070	58	59	0	0	0	0
RAD	0000	0.070	60	61	0	0	0	0

ESAM INTERNAL RAD AND COND TERMS V2

RAD	0000	24.200	30	1	0	0	0	0
RAD	0000	4.210	31	2	0	0	0	0
RAD	0000	4.300	32	2	0	0	0	0
RAD	0000	2.860	33	3	0	0	0	0
RAD	0000	2.920	34	3	0	0	0	0
RAD	0000	4.330	35	4	0	0	0	0
RAD	0000	4.330	36	5	0	0	0	0
RAD	0000	10.300	40	6	0	0	0	0
RAD	0000	3.160	41	7	0	0	0	0
RAD	0000	4.820	42	7	0	0	0	0
RAD	0000	2.090	43	8	0	0	0	0
RAD	0000	2.610	44	8	0	0	0	0
RAD	0000	4.390	45	10	0	0	0	0
RAD	0000	1.480	46	9	0	0	0	0
RAD	0000	3.180	47	9	0	0	0	0
RAD	0000	21.800	50	9	0	0	0	0
RAD	0000	10.300	51	17	0	0	0	0
RAD	0000	80.600	53	38	0	0	0	0
RAD	0000	83.000	54	37	0	0	0	0
RAD	0000	70.500	56	49	0	0	0	0
RAD	0000	71.400	57	50	0	0	0	0
RAD	0000	342.000	62	37	0	0	0	0
GENERATED NODE		62						
RAD	0000	342.000	62	38	0	0	0	0
RAD	0000	342.000	65	49	0	0	0	0
GENERATED NODE		65						
RAD	0000	342.000	65	50	0	0	0	0
COND	0000	0.388	30	13	0	0	0	0
COND	0000	0.388	30	16	0	0	0	0
COND	0000	1.190	30	53	0	0	0	0
COND	0000	9.850	53	62	0	0	0	0
COND	0000	9.850	62	54	0	0	0	0
COND	0000	1.590	54	40	0	0	0	0
COND	0000	1.590	57	40	0	0	0	0
COND	0000	9.850	57	65	0	0	0	0
COND	0000	9.850	65	56	0	0	0	0
COND	0000	1.190	56	30	0	0	0	0
COND	0000	0.467	40	13	0	0	0	0
COND	0000	0.467	40	16	0	0	0	0
COND	0000	46.900	55	65	0	0	0	0
COND	0000	46.900	52	62	0	0	0	0
COND	0000	3.790	53	38	0	0	0	0
COND	0000	3.790	54	37	0	0	0	0
COND	0000	4.030	62	38	0	0	0	0
COND	0000	4.030	62	37	0	0	0	0
COND	0000	1.770	37	39	0	0	0	0
COND	0000	1.770	38	39	0	0	0	0
COND	0000	1.610	36	37	0	0	0	0
COND	0000	1.610	35	38	0	0	0	0
COND	0000	1.100	35	34	0	0	0	0
COND	0000	1.100	36	33	0	0	0	0
COND	0000	4.380	37	38	0	0	0	0
COND	0000	0.865	11	12	0	0	0	0
COND	0000	1.100	33	39	0	0	0	0
COND	0000	1.100	34	39	0	0	0	0
COND	0000	1.080	33	34	0	0	0	0
COND	0000	0.973	11	33	0	0	0	0
COND	0000	0.424	11	36	0	0	0	0
COND	0000	0.812	11	37	0	0	0	0
COND	0000	0.495	11	39	0	0	0	0

COND	0000	0 973	12	34	0	0	0	0
COND	0000	0 424	12	35	0	0	0	0
COND	0000	0 812	12	38	0	0	0	0
COND	0000	0 495	12	39	0	0	0	0
COND	0000	3 180	57	50	0	0	0	0
COND	0000	4 590	56	49	0	0	0	0
COND	0000	2 180	50	49	0	0	0	0
COND	0000	2 230	13	16	0	0	0	0
COND	0000	3 790	49	45	0	0	0	0
COND	0000	1 180	45	43	0	0	0	0
COND	0000	0 964	43	44	0	0	0	0
COND	0000	1 020	44	47	0	0	0	0
COND	0000	1 260	47	46	0	0	0	0
COND	0000	2 250	47	50	0	0	0	0
COND	0000	1 650	46	50	0	0	0	0
COND	0000	1 690	50	48	0	0	0	0
COND	0000	1 800	49	48	0	0	0	0
COND	0000	0 973	48	44	0	0	0	0
COND	0000	0 973	48	43	0	0	0	0
COND	0000	0 800	15	44	0	0	0	0
COND	0000	1 120	15	47	0	0	0	0
COND	0000	1 120	15	48	0	0	0	0
COND	0000	1 120	15	50	0	0	0	0
COND	0000	1 120	14	43	0	0	0	0
COND	0000	0 630	14	45	0	0	0	0
COND	0000	0 630	14	48	0	0	0	0
COND	0000	0 516	14	49	0	0	0	0
COND	0000	1 500	14	15	0	0	0	0
COND	0000	25 100	22	21	0	0	0	0
COND	0000	1 280	21	20	0	0	0	0
COND	0000	0 639	20	58	0	0	0	0
COND	0000	1 660	58	59	0	0	0	0
COND	0000	1 070	21	33	0	0	0	0
COND	0000	1 560	20	33	0	0	0	0
COND	0000	25 100	25	24	0	0	0	0
COND	0000	1 280	24	23	0	0	0	0
COND	0000	0 639	23	60	0	0	0	0
COND	0000	1 660	60	61	0	0	0	0
COND	0000	1 070	23	47	0	0	0	0
COND	0000	1 560	24	47	0	0	0	0
COND	0000	0 315	54	13	0	0	0	0
COND	0000	2 230	62	13	0	0	0	0
COND	0000	0 315	53	13	0	0	0	0
COND	0000	0 315	57	16	0	0	0	0
COND	0000	2 230	65	16	0	0	0	0
COND	0000	0 315	56	16	0	0	0	0
COND	0000	0 050	80	53	0	0	0	0
GENERATED NODE		80						
COND	0000	0 050	80	54	0	0	0	0
COND	0000	0 050	80	56	0	0	0	0
COND	0000	0 050	80	57	0	0	0	0

ESAM POWERS FOR B=23.9

POWR	0000	1	78.810	9.750
			0.000	13.190
			4.120	12.800
			8.230	11.880
			12.350	10.520
			16.470	9.070
			20.590	9.110
			24.700	13.510
			28.820	20.920
			31.460	25.850
			32.940	5.080
			37.050	5.080
			41.170	5.080
			45.290	5.090
			49.410	5.090
			53.520	5.090
			57.640	5.090
			61.760	5.060
			65.420	20.010
			65.870	19.020
			69.990	11.280
			74.110	8.480
			78.220	8.370
			82.340	9.980
			86.460	11.320
			90.580	12.360
			94.690	13.030
			98.810	13.190
POWR	0000	2	98.810	2.530
			0.000	3.450
			4.120	3.320
			8.230	3.030
			12.350	2.980
			16.470	2.530
			20.590	2.130
			24.700	5.990
			28.820	9.610
			31.460	10.870
			32.940	0.720
			37.050	0.720
			41.170	0.720
			45.290	0.720
			49.410	0.720
			53.520	0.720
			57.640	0.720
			61.760	0.720
			65.420	4.270
			65.870	4.030
			69.990	2.400
			74.110	1.700
			78.220	1.730
			82.340	2.310
			86.460	2.790
			90.580	3.160
			94.690	3.390
			98.810	3.450
POWR	0000	3	98.810	2.610
			0.000	3.660
			4.120	3.570
			8.230	3.360

			12 350	3 110
			16 470	2 820
			20 590	2 480
			24 700	2 710
			28 820	3 110
			31 460	3 290
			32 940	1 900
			37.050	1 900
			41 170	1 900
			45 290	1 900
			49 410	1 900
			53 520	1.900
			57 640	1 900
			61 760	1 900
			65.420	2.650
			65 870	2 620
			69 990	2 290
			74 110	2 130
			78 220	2.450
			82 340	2 870
			86 460	3 210
			90 580	3.380
			94 690	3 630
			98 810	3.660
POWR	0000	4	98 810	1 510
			0.000	2 020
			4 120	[illegible] 950
			8 230	790
			12.350	1.560
			16 470	1.320
			20 590	1.260
			24 700	1 960
			28 820	2.650
			31 460	3 080
			32 940	0.750
			37 050	0 750
			41 170	0 750
			45 290	0.750
			49.410	0 750
			53 520	0 750
			57 640	0 750
			61.760	0 740
			65 420	4 380
			65 870	4 180
			69 990	2 430
			74 110	1 400
			78 220	1 320
			82 340	1 580
			86 460	1 770
			90 580	1 910
			94 690	2 010
			98 810	2 020
POWR	0000	5	98 810	3 900
			0 000	2 320
			4 120	2 280
			8 230	3 260
			12 350	8 260
			16 470	12 360
			20 590	13 480
			24 700	13 960
			28 820	13 810

ORIGINAL PAGE IS
OF POOR QUALITY

			31.460	13.340
			32.940	1.110
			37.050	1.110
			41.170	1.110
			45.290	1.110
			49.410	1.110
			53.520	1.110
			57.640	1.110
			61.760	1.100
			65.420	1.480
			65.870	1.450
			69.990	1.260
			74.110	1.220
			78.220	1.420
			82.340	1.700
			86.460	1.950
			90.580	2.140
			94.690	2.270
			98.810	2.320
POWR	0000	6	98.810	8.570
			0.000	5.410
			4.120	5.330
			8.230	5.960
			12.350	13.290
			16.470	24.160
			20.590	30.790
			24.700	32.720
			28.820	31.980
			31.460	30.890
			32.940	2.590
			37.050	2.590
			41.170	2.590
			45.290	2.590
			49.410	2.590
			53.520	2.590
			57.640	2.600
			61.760	2.580
			65.420	3.740
			65.870	3.630
			69.990	3.010
			74.110	2.960
			78.220	3.380
			82.340	4.000
			86.460	4.560
			90.580	5.010
			94.690	5.300
			98.810	5.410
POWR	0000	7	98.810	2.430
			0.000	3.530
			4.120	3.390
			8.230	3.080
			12.350	2.660
			16.470	2.250
			20.590	3.590
			24.700	5.260
			28.820	3.690
			31.460	5.550
			32.940	0.730
			37.050	0.730
			41.170	0.730
			45.290	0.730

		49 410	0 730
		53 520	0 730
		57 640	0 730
		61 760	0 730
		65 420	5 370
		65 870	4 840
		69 990	3 570
		74 110	2 550
		78 220	2 240
		82 340	2 600
		86 460	2 980
		90 580	3 270
		94 690	3 480
		98 810	3 530
POWR 0000	8	98 810	3 050
		0 000	2 670
		4 120	2 600
		8 230	2 440
		12 350	2 210
		16 470	2 730
		20 590	4 960
		24 700	7 150
		28 820	7 310
		31 460	7 870
		32 940	1 200
		37 050	1 200
		41 170	1 200
		45 290	1 200
		49 410	1 200
		53 520	1 200
		57 640	1 200
		61 760	1 200
		65 420	7 830
		65 870	7 710
		69 990	7 160
		74 110	6 140
		78 220	2 330
		82 340	2 110
		86 460	2 350
		90 580	2 530
		94 690	2 650
		98 810	2 670
POWR 0000	9	98 810	3 240
		0 000	2 550
		4 120	2 510
		8 230	2 390
		12 350	2 670
		16 470	5 510
		20 590	10 190
		24 700	12 440
		28 820	12 780
		31 460	12 780
		32 940	1 230
		37 050	1 230
		41 170	1 230
		45 290	1 230
		49 410	1 230
		53 520	1 230
		57 640	1 230
		61 750	1 230
		65 420	2 030

			65.870	1.960
			69.990	1.520
			74.110	1.420
			78.220	1.630
			82.340	1.920
			86.460	2.170
			90.580	2.380
			94.690	2.510
			98.810	2.550
POWR	0000	10	98.810	1.880
			0.000	2.100
			4.120	2.020
			8.230	1.870
			12.350	1.640
			16.470	1.400
			20.590	1.370
			24.700	1.900
			28.820	2.600
			31.460	3.240
			32.940	0.790
			37.050	0.790
			41.170	0.790
			45.290	0.790
			49.410	0.790
			53.520	0.790
			57.640	0.790
			61.760	0.780
			65.420	7.730
			65.870	7.520
			69.990	5.650
			74.110	3.830
			78.220	1.470
			82.340	1.610
			86.460	1.830
			90.580	1.990
			94.690	2.080
			98.810	2.100
POWR	0000	11	98.810	1.710
			0.000	1.880
			4.120	1.860
			8.230	1.820
			12.350	1.770
			16.470	1.690
			20.590	1.610
			24.700	1.640
			28.820	2.040
			31.460	2.280
			32.940	1.540
			37.050	1.540
			41.170	1.540
			45.290	1.540
			49.410	1.540
			53.520	1.540
			57.640	1.540
			61.760	1.540
			65.420	2.270
			65.870	2.230
			69.990	1.760
			74.110	1.570
			78.220	1.650
			82.340	1.730

ORIGINAL PAGE IS
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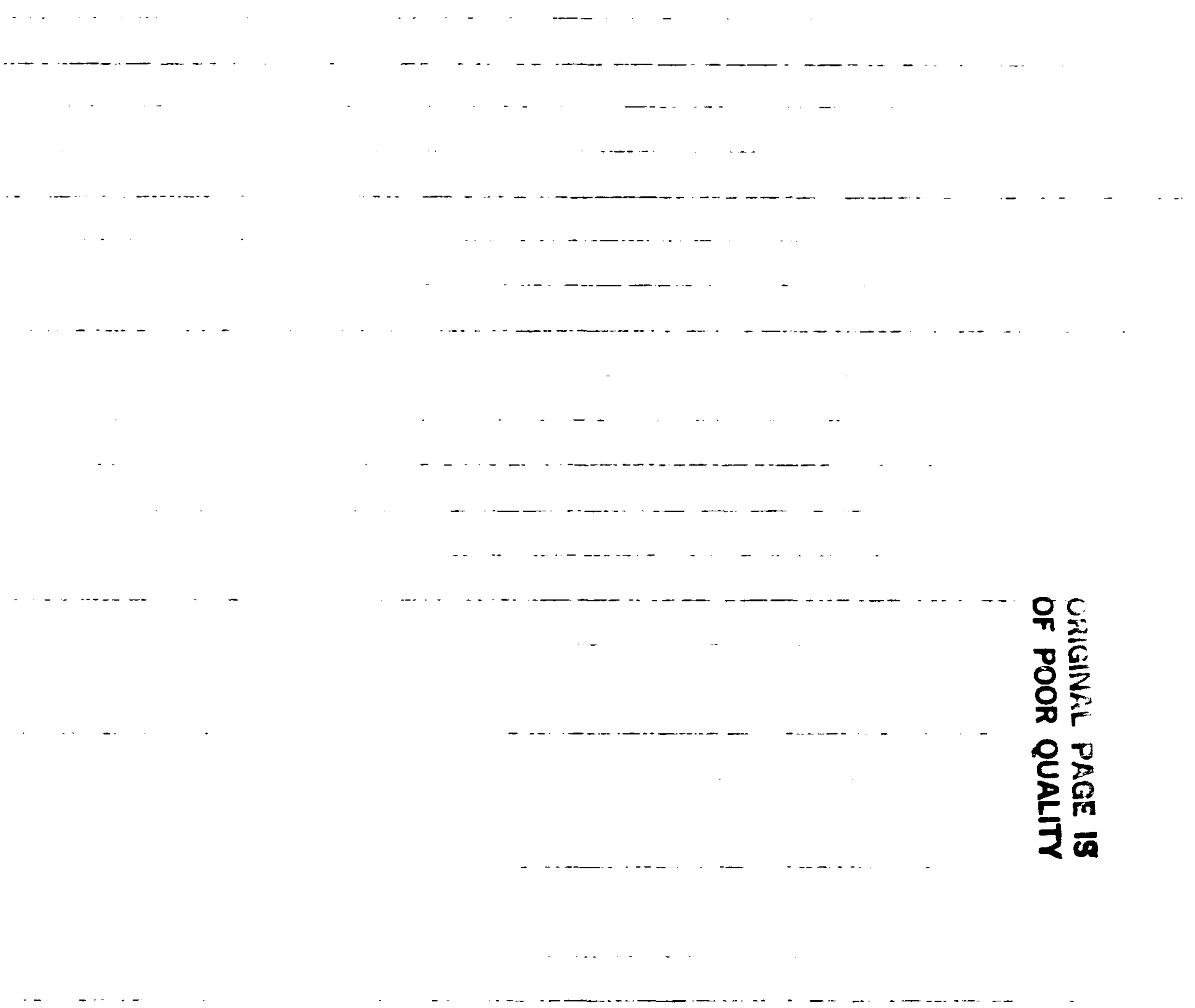
			86 460	1 800
			90 580	1 850
			94 690	1 870
			98 810	1 880
POWR	0000	12	98 810	1 750
			0 000	1 920
			4 120	1.900
			8.230	1 860
			12.350	1 810
			16 470	1 730
			20 590	1 650
			24 700	1.680
			28.820	2 080
			31 460	2 330
			32 940	1 580
			37.050	1 580
			41 170	1.580
			45.290	1 580
			49.410	1 580
			53 520	1 580
			57.640	1.580
			61 760	1 580
			65 420	2.320
			65 870	2 280
			69 990	1 800
			74.110	1.600
			78 220	1.690
			82 340	1 770
			86.460	1 840
			90 580	1.890
			94.690	1.920
			98 810	1 920
POWR	0000	13	98 810	4 170
			0 000	4 600
			4 120	4 550
			8 230	4 460
			12 350	4 320
			16.470	4 140
			20.590	3 930
			24 700	4.010
			28 820	4 980
			31 460	5 560
			32 940	3 770
			37 050	3.770
			41 170	3 770
			45 290	3 770
			49 410	3 770
			53 520	3 770
			57 640	3 770
			61 760	3.770
			65 420	5 560
			65.870	5 460
			69 990	4 320
			74 110	3 830
			78 220	4 030
			82.340	4 230
			86 460	4 390
			90 580	4 510
			94 690	4 580
			98 810	4 600
POWR	0000	14	98 810	1 900

			0.000	2.090
			4.120	2.070
			8.230	2.030
			12.350	1.960
			16.470	1.880
			20.590	1.790
			24.700	1.820
			28.820	2.260
			31.460	2.530
			32.940	1.710
			37.050	1.710
			41.170	1.710
			45.290	1.710
			49.410	1.710
			53.520	1.710
			57.640	1.710
			61.760	1.710
			65.420	2.530
			65.870	2.480
			69.990	2.010
			74.110	1.740
			78.220	1.830
			82.340	1.920
			86.460	2.000
			90.580	2.050
			94.690	2.080
			98.810	2.090
POWR	0000	15	98.810	1.850
			0.000	2.030
			4.120	2.010
			8.230	1.970
			12.350	1.910
			16.470	1.830
			20.590	1.740
			24.700	1.750
			28.820	2.200
			31.460	2.460
			32.940	1.670
			37.050	1.670
			41.170	1.670
			45.290	1.670
			49.410	1.670
			53.520	1.670
			57.640	1.670
			61.760	1.670
			65.420	2.460
			65.870	2.410
			69.990	1.980
			74.110	1.690
			78.220	1.780
			82.340	1.870
			86.460	1.940
			90.580	1.990
			94.690	2.020
			98.810	2.030
POWR	0000	16	98.810	4.270
			0.000	4.700
			4.120	4.660
			8.230	4.560
			12.350	4.410
			16.470	4.230



		20.590	4.020
		24.700	4.080
		28.820	5.090
		31.460	5.680
		32.940	3.850
		37.050	3.850
		41.170	3.850
		45.290	3.850
		49.410	3.850
		53.520	3.850
		57.640	3.850
		61.760	3.850
		65.420	5.680
		65.870	5.580
		69.990	4.400
		74.110	3.920
		78.220	4.120
		82.340	4.320
		86.460	4.490
		90.580	4.610
		94.690	4.680
		98.810	4.700
POWR 0000	17	98.810	3.100
		0.000	4.500
		4.120	4.330
		8.230	3.930
		12.350	3.430
		16.470	3.630
		20.590	4.620
		24.700	5.240
		28.820	8.150
		31.460	10.730
		32.940	0.870
		37.050	0.870
		41.170	0.870
		45.290	0.870
		49.410	0.870
		53.520	0.870
		57.640	0.870
		61.760	0.870
		65.420	6.440
		65.870	5.920
		69.990	3.090
		74.110	2.760
		78.220	2.550
		82.340	3.160
		86.460	3.710
		90.580	4.140
		94.690	4.430
		98.810	4.500
POWR 0000	18	98.810	152.730
		0.000	167.210
		4.120	165.120
		8.230	160.400
		12.350	153.900
		16.470	146.710
		20.590	142.650
		24.700	156.140
		28.820	178.790
		31.460	206.940
		32.940	125.660

			37.050	125.650
			41.170	125.610
			45.290	125.660
			49.410	125.660
			53.520	125.680
			57.640	125.670
			61.760	125.630
			65.420	226.060
			65.870	221.160
			69.990	188.820
			74.110	171.190
			78.220	164.140
			82.340	166.720
			86.460	166.400
			90.580	164.990
			94.690	166.460
			98.810	167.210
POWR	0000	19	98.810	11.740
			0.000	12.770
			4.120	12.620
			8.230	12.300
			12.350	11.910
			16.470	11.420
			20.590	11.330
			24.700	16.090
			28.820	20.520
			31.460	21.910
			32.940	9.700
			37.050	9.700
			41.170	9.690
			45.290	9.690
			49.410	9.700
			53.520	9.690
			57.640	9.700
			61.760	9.710
			65.420	13.490
			65.870	13.210
			69.990	11.320
			74.110	10.660
			78.220	10.790
			82.340	11.450
			86.460	12.010
			90.580	12.430
			94.690	12.690
			98.810	12.770
POWR	0000	20	98.810	0.790
			0.000	0.820
			4.120	0.800
			8.230	0.780
			12.350	0.870
			16.470	1.040
			20.590	1.110
			24.700	1.240
			28.820	1.370
			31.460	1.470
			32.940	0.580
			37.050	0.580
			41.170	0.580
			45.290	0.580
			49.410	0.580
			53.520	0.580

			57.640	0.580
			61.760	0.580
			65.420	1.220
			65.870	1.190
			69.990	0.880
			74.110	0.610
			78.220	0.660
			82.340	0.710
			86.460	0.760
			90.580	0.790
			94.690	0.810
			98.810	0.820
POWR	0000	21	98.810	0.180
			0.000	0.170
			4.120	0.170
			8.230	0.160
			12.350	0.300
			16.470	0.460
			20.590	0.470
			24.700	0.510
			28.820	0.560
			31.460	0.600
			32.940	0.030
			37.050	0.030
			41.170	0.030
			45.290	0.030
			49.410	0.030
			53.520	0.030
			57.640	0.030
			61.760	0.030
			65.420	0.500
			65.870	0.490
			69.990	0.320
			74.110	0.050
			78.220	0.080
			82.340	0.110
			86.460	0.140
			90.580	0.160
			94.690	0.170
			98.810	0.170
POWR	0000	22	98.810	0.480
			0.000	0.800
			4.120	0.770
			8.230	0.720
			12.350	0.630
			16.470	0.530
			20.590	0.420
			24.700	0.400
			28.820	0.450
			31.460	0.470
			32.940	0.320
			37.050	0.320
			41.170	0.320
			45.290	0.320
			49.410	0.320
			53.520	0.320
			57.640	0.320
			61.760	0.320
			65.420	0.370
			65.870	0.370
			69.990	0.340

			74.110	0.360
			78.220	0.460
			82.340	0.580
			86.460	0.670
			90.580	0.750
			94.690	0.790
			98.810	0.800
POWR	0000	23	98.810	0.750
			0.000	0.780
			4.120	0.770
			8.230	0.740
			12.350	0.770
			16.470	1.110
			20.590	1.270
			24.700	1.180
			28.820	1.120
			31.460	1.170
			32.940	0.550
			37.050	0.550
			41.170	0.550
			45.290	0.550
			49.410	0.550
			53.520	0.550
			57.640	0.550
			61.760	0.550
			65.420	1.010
			65.870	0.980
			69.990	0.730
			74.110	0.610
			78.220	0.630
			82.340	0.680
			86.460	0.720
			90.580	0.760
			94.690	0.770
			98.810	0.780
POWR	0000	24	98.810	0.170
			0.000	0.170
			4.120	0.160
			8.230	0.140
			12.350	0.320
			16.470	0.470
			20.590	0.410
			24.700	0.350
			28.820	0.320
			31.460	0.350
			32.940	0.030
			37.050	0.030
			41.170	0.030
			45.290	0.030
			49.410	0.030
			53.520	0.030
			57.640	0.030
			61.760	0.030
			65.420	0.430
			65.870	0.410
			69.990	0.300
			74.110	0.160
			78.220	0.080
			82.340	0.110
			86.460	0.130
			90.580	0.150

		94.690	0.170
		98.810	0.170
POWR-0000	25	98.810	1.110
		0.000	0.790
		4.120	0.780
		8.230	0.740
		12.350	1.520
		16.470	3.160
		20.590	3.780
		24.700	4.170
		28.820	4.400
		31.460	4.420
		32.940	0.320
		37.050	0.320
		41.170	0.320
		45.290	0.320
		49.410	0.320
		53.520	0.320
		57.640	0.320
		61.760	0.320
		65.420	0.340
		65.870	0.340
		69.990	0.330
		74.110	0.340
		78.220	0.430
		82.340	0.550
		86.460	0.650
		90.580	0.730
		94.490	0.780
		98.810	0.790

ORIGINAL PAGE IS
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ESAM LENS POWERS FOR B-23.4

POWR	0000	59	98 810	0 140
			0 000	0 430
			4 120	0 400
			8 230	0 360
			12 350	0 280
			16 470	0 190
			20 590	0 090
			24 700	0 070
			28 820	0 120
			31 460	0 130
			32 940	0 000
			61 760	0 000
			65 430	0 040
			65 870	0 040
			69 990	0 020
			74 110	0 040
			78 220	0 120
			82 340	0 230
			86 460	0 310
			90 580	0 380
			94 690	0 420
			98 810	0 430
POWR	0000	61	98 810	0 700
			0 000	0 430
			4 120	0 410
			8 230	0 370
			12 350	1 070
			16 470	2 540
			20 590	3 080
			24 700	3 430
			28 820	3 640
			31 460	3 650
			32 940	0 000
			61 760	0 000
			65 430	0 030
			65 870	0 020
			69 990	0 010
			74 110	0 020
			78 220	0 110
			82 340	0 210
			86 460	0 290
			90 580	0 370
			94 690	0 410
			98 810	0 430
POWR	0000	22	98 810	-0 140
			0 000	-0 430
			4 120	-0 400
			8 230	-0 360
			12 350	-0 280
			16 470	-0 190
			20 590	-0 090
			24 700	-0 070
			28 820	-0 120
			31 460	-0 130
			32 940	0 000
			61 760	0 000
			65 430	-0 040
			65 870	-0 040
			69 990	-0 020
			74 110	-0 040

		78.220	-0.120
		82.340	-0.230
		86.460	-0.310
		90.580	-0.380
		94.690	-0.420
		98.810	-0.430
POWR 0000	25	98.810	-0.700
		0.000	-0.430
		4.120	-0.410
		8.230	-0.370
		12.350	-1.070
		16.470	-2.540
		20.590	-3.080
		24.700	-3.430
		28.820	-3.640
		31.460	-3.650
		32.940	0.000
		61.760	0.000
		65.430	-0.030
		65.870	-0.020
		69.990	-0.010
		74.110	-0.020
		78.220	-0.110
		82.340	-0.210
		86.460	-0.290
		90.580	-0.370
		94.690	-0.410
		98.810	-0.430

ESAM POWERS FOR B=41.8

POWR 0000	1	98.810	10.040
		0.000	11.680
		4.120	11.250
		8.230	10.410
		12.350	9.470
		16.470	9.110
		20.590	10.800
		24.700	15.550
		28.820	21.820
		32.360	25.120
		32.940	5.090
		37.050	5.090
		41.170	5.090
		45.290	5.090
		49.410	5.090
		53.520	5.090
		57.640	5.090
		61.760	5.080
		62.460	20.490
		65.870	16.030
		69.990	10.940
		74.110	8.870
		78.220	8.670
		82.340	9.430
		86.460	10.430
		90.580	11.210
		94.690	11.660
		98.810	11.680
POWR 0000	2	98.810	2.470
		0.000	2.940
		4.120	2.800
		8.230	2.530
		12.350	2.200
		16.470	2.380
		20.590	4.100
		24.700	6.400
		28.820	8.460
		32.360	9.580
		32.940	0.720
		37.050	0.720
		41.170	0.720
		45.290	0.720
		49.410	0.720
		53.520	0.720
		57.640	0.720
		61.760	0.720
		62.460	3.390
		65.870	2.260
		69.990	1.680
		74.110	1.480
		78.220	1.740
		82.340	2.120
		86.460	2.500
		90.580	2.780
		94.690	2.930
		98.810	2.940
POWR 0000	3	98.810	2.490
		0.000	3.280
		4.120	3.180
		8.230	3.000

			12.350	2.760
			16.470	2.530
			20.590	2.480
			24.700	2.670
			28.820	2.940
			32.360	3.100
			32.940	1.900
			37.050	1.900
			41.170	1.900
			45.290	1.900
			49.410	1.900
			53.520	1.900
			57.640	1.900
			61.760	1.900
			62.460	2.450
			65.870	2.260
			69.990	2.100
			74.110	2.120
			78.220	2.410
			82.340	2.720
			86.460	2.990
			90.580	3.180
			94.690	3.280
			98.810	3.280
POWR	0000	4	98.810	1.500
			0.000	1.770
			4.120	1.700
			8.230	1.550
			12.350	1.390
			16.470	1.300
			20.590	1.530
			24.700	2.050
			28.820	2.610
			32.360	2.870
			32.940	0.750
			37.050	0.750
			41.170	0.750
			45.290	0.750
			49.410	0.750
			53.520	0.750
			57.640	0.750
			61.760	0.750
			62.460	3.650
			65.870	2.880
			69.990	1.970
			74.110	1.450
			78.220	1.360
			82.340	1.450
			86.460	1.610
			90.580	1.720
			94.690	1.780
			98.810	1.770
POWR	0000	5	98.810	3.560
			0.000	2.100
			4.120	2.060
			8.230	2.870
			12.350	7.240
			16.470	10.610
			20.590	11.690
			24.700	11.960
			28.820	11.670

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS
OF POOR QUALITY

			32.360	10.910
			32.940	1.110
			37.050	1.110
			41.170	1.110
			45.290	1.110
			49.410	1.110
			53.520	1.110
			57.640	1.110
			61.760	1.110
			62.460	1.430
			65.870	1.250
			69.990	1.200
			74.110	1.230
			78.220	1.430
			82.340	1.650
			86.450	1.840
			90.580	1.990
			94.690	2.080
			98.810	2.100
POWR	0000	6	98.810	7.460
			0.000	4.900
			4.120	4.800
			8.230	5.160
			12.350	9.150
			16.470	17.860
			20.590	24.240
			24.700	27.050
			28.820	26.730
			32.360	24.720
			32.940	2.590
			37.050	2.590
			41.170	2.590
			45.290	2.590
			49.410	2.590
			53.520	2.590
			57.640	2.590
			61.760	2.590
			62.460	3.470
			65.870	3.100
			69.990	3.000
			74.110	3.010
			78.220	3.410
			82.340	3.880
			86.460	4.310
			90.580	4.640
			94.690	4.850
			98.810	4.900
POWR	0000	7	98.810	2.970
			0.000	3.010
			4.120	2.860
			8.230	2.590
			12.350	2.260
			16.470	2.080
			20.590	2.790
			24.700	6.470
			28.820	8.590
			32.360	6.840
			32.940	0.730
			37.050	0.730
			41.170	0.730
			45.290	0.730

			49.410	0.730
			53.520	0.730
			57.640	0.730
			61.760	0.730
			62.460	6.860
			65.870	8.470
			69.990	6.490
			74.110	2.660
			78.220	2.240
			82.340	2.370
			86.460	2.640
			90.580	2.860
			94.690	3.000
			98.810	3.010
POWR	0000	8	98.810	4.500
			0.000	2.430
			4.120	2.380
			8.230	2.210
			12.350	2.700
			16.470	5.020
			20.590	8.730
			24.700	11.030
			28.820	11.070
			32.360	11.260
			32.940	1.200
			37.050	1.200
			41.170	1.200
			45.290	1.200
			49.410	1.200
			53.520	1.200
			57.640	1.200
			61.760	1.200
			62.460	11.270
			65.870	11.080
			69.990	11.060
			74.110	8.870
			78.220	5.060
			82.340	2.810
			86.460	2.220
			90.580	2.380
			94.690	2.430
			98.810	2.430
POWR	0000	9	98.810	2.870
			0.000	2.320
			4.120	2.270
			8.230	2.150
			12.350	2.210
			16.470	3.660
			20.590	7.170
			24.700	9.820
			28.820	10.730
			32.360	10.360
			32.940	1.230
			37.050	1.230
			41.170	1.230
			45.290	1.230
			49.410	1.230
			53.520	1.230
			57.640	1.230
			61.760	1.230
			62.460	2.190

ORIGINAL PAGE IS
OF POOR QUALITY

			65.870	1.850
			69.990	1.590
			74.110	1.490
			78.220	1.660
			82.340	1.860
			86.460	2.050
			90.580	2.200
			94.690	2.300
			98.810	2.320
POWR	0000	10	98.810	2.400
			0.000	1.860
			4.120	1.780
			8.230	1.640
			12.350	1.430
			16.470	1.420
			20.590	1.640
			24.700	2.210
			28.820	2.820
			32.360	3.090
			32.940	0.790
			37.050	0.790
			41.170	0.790
			45.290	0.790
			49.410	0.790
			53.520	0.790
			57.640	0.790
			61.760	0.790
			62.460	9.610
			65.870	9.720
			69.990	8.030
			74.110	5.330
			78.220	2.520
			82.340	1.790
			86.460	1.690
			90.580	1.800
			94.690	1.870
			98.810	1.860
POWR	0000	11	98.810	1.700
			0.000	1.820
			4.120	1.800
			8.230	1.760
			12.350	1.710
			16.470	1.650
			20.590	1.580
			24.700	1.710
			28.820	2.020
			32.360	2.270
			32.940	1.540
			37.050	1.540
			41.170	1.540
			45.290	1.540
			49.410	1.540
			53.520	1.540
			57.640	1.540
			61.760	1.540
			62.460	2.270
			65.870	2.030
			69.990	1.610
			74.110	1.580
			78.220	1.650
			82.340	1.710

ORIGINAL PAGE IS OF POOR QUALITY

		96.460	1.760
		90.580	1.800
		94.690	1.820
		98.810	1.820
POWR	0000	12 98.810	1.740
		0.000	1.860
		4.120	1.840
		8.230	1.800
		12.350	1.750
		16.470	1.690
		20.590	1.620
		24.700	1.740
		28.820	2.070
		32.360	2.320
		32.940	1.580
		37.050	1.580
		41.170	1.580
		45.290	1.580
		49.410	1.580
		53.520	1.580
		57.640	1.580
		61.760	1.580
		62.460	2.330
		65.870	2.080
		69.990	1.650
		74.110	1.610
		78.220	1.680
		82.340	1.750
		86.460	1.800
		90.580	1.840
		94.690	1.860
		98.810	1.860
POWR	0000	13 98.810	4.170
		0.000	4.440
		4.120	4.400
		8.230	4.310
		12.350	4.180
		16.470	4.030
		20.590	3.870
		24.700	4.140
		28.820	4.950
		32.360	5.560
		32.940	3.770
		37.050	3.770
		41.170	3.770
		45.290	3.770
		49.410	3.770
		53.520	3.770
		57.640	3.770
		61.760	3.770
		62.460	5.560
		65.870	4.970
		69.990	4.090
		74.110	3.860
		78.220	4.020
		82.340	4.180
		86.460	4.300
		90.580	4.390
		94.690	4.440
		98.810	4.440
POWR	0000	14 98.810	1.900

ORIGINAL PAGE IS
OF POOR QUALITY

			0.000	2.020
			4.120	2.000
			8.230	1.960
			12.350	1.900
			16.470	1.830
			20.590	1.760
			24.700	1.890
			28.820	2.250
			32.360	2.530
			32.940	1.710
			37.050	1.710
			41.170	1.710
			45.290	1.710
			49.410	1.710
			53.520	1.710
			57.640	1.710
			61.760	1.710
			62.460	2.530
			65.870	2.260
			69.990	1.900
			74.110	1.760
			78.220	1.830
			82.340	1.900
			86.460	1.960
			90.580	2.000
			94.690	2.020
			98.810	2.020
POWR	0000	15	98.810	1.840
			0.000	1.960
			4.120	1.940
			8.230	1.900
			12.350	1.850
			16.470	1.780
			20.590	1.710
			24.700	1.830
			28.820	2.190
			32.360	2.460
			32.940	1.670
			37.050	1.670
			41.170	1.670
			45.290	1.670
			49.410	1.670
			53.520	1.670
			57.640	1.670
			61.760	1.670
			62.460	2.460
			65.870	2.200
			69.990	1.850
			74.110	1.710
			78.220	1.780
			82.340	1.850
			86.460	1.900
			90.580	1.940
			94.690	1.960
			98.810	1.960
POWR	0000	16	98.810	4.260
			0.000	4.540
			4.120	4.490
			8.230	4.400
			12.350	4.280
			16.470	4.120

			20.590	3.950
			24.700	4.220
			26.820	5.060
			32.360	5.680
			32.940	3.850
			37.050	3.850
			41.170	3.850
			45.290	3.850
			49.410	3.850
			53.520	3.850
			57.640	3.850
			61.760	3.850
			62.460	5.680
			65.870	5.060
			69.990	4.070
			74.110	3.950
			78.220	4.110
			82.340	4.270
			86.460	4.400
			90.580	4.490
			94.690	4.540
			98.810	4.540
POWR	0000	17	98.810	2.930
			0.000	3.830
			4.120	3.640
			8.230	3.280
			12.350	2.840
			16.470	2.910
			20.590	4.390
			24.700	5.830
			28.820	7.370
			32.360	8.700
			32.940	0.870
			37.050	0.870
			41.170	0.870
			45.290	0.870
			49.410	0.870
			53.520	0.870
			57.640	0.870
			61.760	0.870
			62.460	4.800
			65.870	3.470
			69.990	2.960
			74.110	2.460
			78.220	2.560
			82.340	2.870
			86.460	3.290
			90.580	3.620
			94.690	3.820
			98.810	3.830
POWR	0000	18	98.810	152.780
			0.000	159.440
			4.120	157.260
			8.230	153.150
			12.350	148.290
			16.470	146.610
			20.590	149.300
			24.700	163.400
			28.820	179.600
			32.360	195.480
			32.940	125.640

ORIGINAL PAGE IS
OF POOR QUALITY

			37.050	125.650
			41.170	125.670
			45.290	125.660
			49.410	125.660
			53.520	125.670
			57.640	125.660
			61.760	125.640
			62.460	211.950
			65.870	199.020
			69.990	184.980
			74.110	169.760
			78.220	161.560
			82.340	158.190
			86.460	157.880
			90.580	157.950
			94.690	159.410
			98.810	159.440
POWR	0000	19	98.810	11.690
			0.000	12.200
			4.120	12.040
			8.230	11.740
			12.350	11.360
			16.470	11.590
			20.590	13.730
			24.700	16.550
			28.820	19.000
			32.360	20.230
			32.940	9.690
			37.050	9.690
			41.170	9.690
			45.290	9.700
			49.410	9.700
			53.520	9.700
			57.640	9.690
			61.760	9.690
			62.460	12.450
			65.870	11.110
			69.990	10.500
			74.110	10.360
			78.220	10.780
			82.340	11.250
			86.460	11.680
			90.580	12.010
			94.690	12.190
			98.810	12.200
POWI	0000	20	98.810	0.740
			0.000	0.770
			4.120	0.760
			8.230	0.740
			12.350	0.770
			16.470	0.820
			20.590	0.910
			24.700	1.020
			28.820	1.180
			32.360	1.280
			32.940	0.580
			37.050	0.580
			41.170	0.580
			45.290	0.580
			49.410	0.580
			53.520	0.580

			57.640	0.580
			61.760	0.580
			62.460	-1.070
			65.870	0.890
			69.990	0.680
			74.110	0.620
			78.220	0.660
			82.340	0.700
			86.460	0.730
			90.580	0.760
			94.690	0.770
			98.810	0.770
POWR	0000	21	98.810	0.180
			0.000	0.150
			4.120	0.140
			8.230	0.150
			12.350	0.280
			16.470	0.360
			20.590	0.400
			24.700	0.450
			28.820	0.530
			32.360	0.570
			32.940	0.030
			37.050	0.030
			41.170	0.030
			45.290	0.030
			49.410	0.030
			53.520	0.030
			57.640	0.030
			61.760	0.030
			62.460	0.460
			65.870	0.390
			69.990	0.160
			74.110	0.050
			78.220	0.080
			82.340	0.100
			86.460	0.120
			90.580	0.140
			94.690	0.150
			98.810	0.150
POWR	0000	22	98.810	0.450
			0.000	0.690
			4.120	0.670
			8.230	0.610
			12.350	0.540
			16.470	0.460
			20.590	0.400
			24.700	0.400
			28.820	0.430
			32.360	0.450
			32.940	0.320
			37.050	0.320
			41.170	0.320
			45.290	0.320
			49.410	0.320
			53.520	0.320
			57.640	0.320
			61.760	0.320
			62.460	0.360
			65.870	0.340
			69.990	0.330

			74.110	0.360
			78.220	0.450
			82.340	0.540
			86.460	0.610
			90.580	0.670
			94.690	0.690
			98.810	0.690
POWR	0000	23	98.810	0.770
			0.000	0.740
			4.120	0.720
			8.230	0.700
			12.350	0.730
			16.470	0.990
			20.590	1.200
			24.700	1.270
			28.820	1.300
			32.360	1.310
			32.940	0.550
			37.050	0.550
			41.170	0.550
			45.290	0.550
			49.410	0.550
			53.520	0.550
			57.640	0.550
			61.760	0.550
			62.460	1.140
			65.870	0.960
			69.990	0.770
			74.110	0.680
			78.220	0.680
			82.340	0.680
			86.460	0.700
			90.580	0.720
			94.690	0.740
			98.810	0.740
POWR	0000	24	98.810	0.170
			0.000	0.140
			4.120	0.130
			8.230	0.120
			12.350	0.170
			16.470	0.440
			20.590	0.430
			24.700	0.420
			28.820	0.430
			32.360	0.450
			32.940	0.030
			37.050	0.030
			41.170	0.030
			45.290	0.030
			49.410	0.030
			53.520	0.030
			57.640	0.030
			61.760	0.030
			62.460	0.480
			65.870	0.430
			69.990	0.350
			74.110	0.280
			78.220	0.230
			82.340	0.140
			86.460	0.120
			90.580	0.130

ORIGINAL PAGE IS
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		94.690	0.140
		98.810	0.140
POWR 0000	25	98.810	0.980
		0.000	0.710
		4.120	0.690
		8.230	0.650
		12.350	0.850
		16.470	2.520
		20.590	3.250
		24.700	3.540
		28.820	3.670
		32.360	3.620
		32.940	0.320
		37.050	0.320
		41.170	0.320
		45.290	0.320
		49.410	0.320
		53.520	0.320
		57.640	0.320
		61.760	0.320
		62.460	0.340
		65.870	0.330
		69.990	0.330
		74.110	0.350
		78.220	0.440
		82.340	0.530
		86.460	0.600
		90.580	0.660
		94.690	0.700
		98.810	0.710

ORIGINAL PAGE IS OF POOR QUALITY

ESAM LENS POWERS FOR B=41.8

POWR	0000	59	98.810	0.120
			0.000	0.330
			4.120	0.320
			8.230	0.260
			12.350	0.200
			16.470	0.120
			20.590	0.070
			24.700	0.070
			28.820	0.100
			32.360	0.120
			32.940	0.000
			61.760	0.000
			62.460	0.040
			65.870	0.020
			69.990	0.010
			74.110	0.040
			78.220	0.120
			82.340	0.200
			86.460	0.260
			90.580	0.300
			94.690	0.330
			98.810	0.330
POWR	0000	61	98.810	0.590
			0.000	0.350
			4.120	0.330
			8.230	0.290
			12.350	0.470
			16.470	1.970
			20.590	2.610
			24.700	2.870
			28.820	2.990
			32.360	2.940
			32.940	0.000
			61.760	0.000
			62.460	0.020
			65.870	0.010
			69.990	0.010
			74.110	0.030
			78.220	0.110
			82.340	0.190
			86.460	0.260
			90.580	0.320
			94.690	0.340
			98.810	0.350
POWR	0000	22	98.810	-0.120
			0.000	-0.330
			4.120	-0.320
			8.230	-0.260
			12.350	-0.200
			16.470	-0.120
			20.590	-0.070
			24.700	-0.070
			28.820	-0.100
			32.360	-0.120
			32.940	0.000
			61.760	0.000
			62.460	-0.040
			65.870	-0.020
			69.990	-0.010
			74.110	-0.040

			78.220	-0.120
			82.340	-0.200
			86.460	-0.260
			90.580	-0.300
			94.690	-0.330
			98.810	-0.330
POWR	0000	25	98.810	-0.590
			0.000	-0.350
			4.120	-0.330
			8.230	-0.290
			12.350	-0.470
			16.470	-1.970
			20.590	-2.610
			24.700	-2.870
			28.820	-2.990
			32.360	-2.940
			32.940	0.000
			61.760	0.000
			62.460	-0.020
			65.870	-0.010
			69.990	-0.010
			74.110	-0.030
			78.220	-0.110
			82.340	-0.190
			86.460	-0.260
			90.580	-0.320
			94.690	-0.340
			98.810	-0.350

APPENDIX B. ESAM THERMAL ANALYSIS RESULTS

MEMORANDUM
LDTHER-IOM-81-002
May 20, 1981

OAO CORPORATION

5050 Powder Mill Road • Beltsville, Md. 20705
(301) 937-3090

TO : Dave Mengers

FROM : Doan Eiband

SUBJECT: Results of the Thermal Analysis of the Landsat-D Earth Sensor Assembly Module

REFERENCE: OAO Corporation Memorandum, LDTHER-IOM-81-001, Landsat-D Earth Sensor Assembly Detailed Thermal Model, D. Eiband, May 1981.

The objectives of this study were to evaluate the thermal design of the Landsat-D Earth Sensor Assembly Module (ESAM) and the structural temperature gradients of the ESAM. These goals were achieved by examining the ESAM's sensitivity to various operational conditions. These were the spacecraft orbit, the Multi-mission Modular Spacecraft (MMS) interface temperature, the ESAM supply voltage, and the number of sensors turned on. Combinations of these conditions were run for both steady state and transient cases to predict the temperature response of the ESAM. From these computer runs, the temperature ranges for the possible operational modes were found and, from these, the sensitivities.

The thermal model used for this study is discussed in detail in the referenced memorandum. It basically is a 60-node model which is sufficiently detailed to enable the evaluation of any ESAM temperature gradients. This model was set up in the Simplified Shuttle Payload Thermal Analyzer (SSPTA) computer program format. SSPTA was used since it has the capabilities for calculating the absorbed environmental fluxes, view factors, and nodal temperatures, without having to use other programs.

The first operational parameter examined was the variation in the probable Landsat-D orbit. Two orbits were considered which represent the extreme in fluxes by virtue of their beta angles. These orbits have beta angles of 23.4^{o} and 41.8^{o} with orbital inclinations of 98.2^{o} and the direction of the spacecraft travel from north to south in the daylight portion. Using these orbits, SSPTA calculated the absorbed environmental fluxes on each of the external surfaces and generated flux tables versus time for 24 equal steps in each orbit. These orbital flux tables were used directly except for the fluxes on the quartz lenses. For these absorbed fluxes, the UV components included the transmitted as well as absorbed energy. Consequently, the transmitted portion, about 90% of the total

flux, was subtracted from the lens fluxes and added as internal energy to the sensors. The IR component of the fluxes had no transmitted component and was left unchanged. Subsequent to performing the analyses with properties for the quartz lenses, it was learned that the lenses are germanium, which is opaque to UV and transmits about 20% of the incident IR fluxes. For these lenses, the fluxes were modified in a similar manner as for the quartz lenses to allow a 20% transmission in the IR. The UV component was reduced to account for the lower UV absorption of the germanium. A single steady state temperature case was run to determine the effects of this change. For this $\beta = 23.4^\circ$, normal operational case the ESAM temperatures increased about 1.5°C. These temperature increases are a result of the diminished heat rejection capability of the exterior portion of the sensors because of the lower emittance of the germanium lenses. This forces more of the energy absorbed by the sensor barrels to be conducted into the ESAM structure and not rejected off the lenses.

The next operational parameters considered were the MMS interface temperature and the ESAM power variation. The MMS interface temperature can vary from 10°C to 30°C which corresponds to the temperature range given for the MMS. This interface temperature was applied as a constant temperature boundary node coupled to the ESAM central box walls. The ESAM power can vary as a result of the spacecraft supply voltage ranging from 35V to 22V, with a nominal value of 28V. A table of the sensor and electronics package power level variations versus supply voltage is given in Table 1.

The ESAM temperature responses for the various steady state and transient temperature analysis are presented in Tables 2 through 4. Each of these tables gives the ESAM component temperatures for the radiators, +Y sensor, -Y sensor, and electronics. The structural temperatures are not given since they fall between the temperatures of the electronics and the radiators. Temperature gradients across the ESAM are of the order of 1°C which is why average temperatures for the radiators and electronics are presented in the tables. The sensor temperatures are for the hottest points which are at the ends with the bolometers.

Along with the component temperatures, on these tables are the defining parameters which describe the ESAM operating conditions and environment. These parameters are the orbit beta angle, power supply voltage, MMS interface temperature, heater power, and number of sensors operating. These parameters were varied singly and together to investigate their effect on the ESAM. Each of the tables has a particular grouping of cases to examine these parameters. Table 2 gives the steady state temperature limits for the hottest and coldest possible cases, for the hottest normal operational and coldest normal operational cases, and the coldest single sensor operational case. Table 3 gives the steady state temperature limits for the extremes of orbit, supply voltage, and

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TABLE 1

ESAM Power Supplied Versus Supply Voltage

SUPPLY VOLTAGE (V)	TEMPERATURE (^oC)	ELECTRONICS PACKAGE (W)	SENSOR (W)	ESAM* (W)
35	40	5.5	3.0	17.0
	20	5.5	3.0	17.0
	-10	5.7	4.5	20.4
28	40	4.3	3.0	14.6
	20	4.3	3.0	14.6
	-10	4.5	4.5	18.0
22	40	3.5	3.0	13.0
	20	3.5	3.0	13.0
	-10	3.7	4.5	16.4

* The ESAM has two electronics packages and two sensors.

TABLE 2

ESAM Steady State Temperatues for Limiting Cases (^{o}C)

	HOTTEST POSSIBLE CASE	COLDEST POSSIBLE CASE	HOTTEST NORMAL OPERATION	COLDEST NORMAL OPERATION	COLDEST ONE SENSOR OPERATION
DEFINING PARAMETERS					
ORBIT BETA ANGLE (DEGREES)	23.4	41.8	23.4	41.8	41.8
SUPPLY VOLTAGE (V)	35	22	35	22	22
MMS TEMPERATURE (^{o}C)	30	10	30	10	10
HEATER POWER (W)	20.4	NONE	NONE	NONE	NONE
SENSORS OPERATING	BOTH	NONE	BOTH	BOTH	+Y ONLY
COMPONENT TEMPERATURES					
RADIATORS	40.2	-12.1	17.1	7.9	- 2.1
+Y SENSOR	45.5	-12.4	23.3	14.3	5.1
-Y SENSOR	46.5	-11.0	24.7	15.5	- 2.0
ELECTRONICS	42.6	-11.8	18.2	8.6	+Y - 1.1 -Y - 2.3

TABLE 3

ESAM Steady State Temperatures for Parameter Sensitivity

	EXTREME ORBIT BETA ANGLES		EXTREME SUPPLY VOLTAGE		EXTREME MMS TEMPERATURE	
	23.4^{o}	41.8^{o}	35V	22V	$30^{o}C$	$10^{o}C$
DEFINING PARAMETERS						
ORBIT BETA ANGLE (DEGREES)	23.4	41.8	23.4	23.4	23.4	23.4
SUPPLY VOLTAGE (V)	28	28	35	22	28	28
MMS TEMPERATURE (^{o}C)	20	20	20	20	30	10
HEATER POWER (W)	NONE	NONE	NONE	NONE	NONE	NONE
SENSORS OPERATING	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
COMPONENT TEMPERATURES (^{o}C)						
RADIATORS	12.6	11.7	15.7	10.4	15.2	9.9
+Y SENSOR	19.0	18.0	22.0	16.9	21.5	16.3
-Y SENSOR	20.4	19.1	23.4	18.3	22.9	17.8
ELECTRONICS	13.4	12.6	16.7	11.2	16.1	10.7

MMS Temperature. Table 4 gives the component orbital transient temperature. variations for normal operations and single sensor operations.

These analyses indicate that the ESAM thermal design is adequate to maintain the ESAM within the normal operational limits of -10°C to 35°C using passive thermal control. The actual normal operational steady state temperature range found for the structure was from 8.6°C to 18.2°C with a nominal temperature of about 13°C. With the ESAM sensors off and the heaters disabled structural temperature stabilizes at -11.8°C, just below the lower temperature limit. The only sensors on case which exceeded these temperature limits was the hottest possible case which predicted a steady state structural temperature of 42.6°C. This case is unlikely to occur in flight since it requires both proportional heaters systems to fail on at full power, and both sensors to continue to operate.

The active portions of the ESAM thermal design are the proportional heaters, which are supposed to maintain the ESAM temperature within the operational limits during single sensor or no sensor operational modes. It was found that the heater capabilities were more than sufficient to maintain the ESAM within the temperature limits with both sensors turned off. In fact the heaters can supply a peak power of 20.4W at nominal supply voltage levels, while only 14.6W of operational power stabilizes the ESAM structure at 13.4°C. Even at the minimum voltage, the heaters can supply 12.6W peak power which is more than enough to stabilize the temperatures above the lower heater control point.

The operation of the proportional heaters is controlled by the selection of appropriate control range and thermostat locations. For the ESAM, the fully off to fully on range is from -5°C to +5°C, respectively, to move the control range out of the normal ESAM operational temperature range. (The coldest normal operational case had a structural temperature of 8.6°C, slightly above the heater set point.) The only remaining question on ESAM was where on the structure to locate the thermostats. These analyses indicated that the structural temperature variations are small enough in ESAM to allow the location of the thermostats at any convenient point, since the structure is essentially isothermal.

The ESAM thermal design sensitivities to the various operational parameters were also determined in these analyses. These sensitivities were found by evaluating the steady state temperature variations for ESAM over the maximum range of each of the operational parameters. The parameters of interest were the orbit variation, MMS temperature variation, and supply voltage variation. The resulting ESAM temperature sensitivities are: a 1°C change over the range of flux conditions, 0.3°C change for a 1°C change in the MMS temperature, and 0.4°C change for a 1V change in the supply voltage.

TABLE 4

ESAM Transient Temperatures for Normal and Single Sensor Operation

	NORMAL SENSOR OPERATION			ONE SENSOR OPERATION		
	ORBITAL AVERAGE	MAXIMUM	MINIMUM	ORBITAL AVERAGE	MAXIMUM	MINIMUM
DEFINING PARAMETERS						
ORBIT BETA ANGLE (DEGREES)	23.4	-	-	23.4	-	-
SUPPLY VOLTAGE (V)	28	-	-	22	-	-
MMS TEMPERATURE (°C)	20	-	-	10	-	-
HEATER POWER (W)	NONE	-	-	NONE	-	-
SENSOR OPERATING	BOTH	-	-	BOTH	-	-
COMPONENT TEMPERATURES (°C)						
+Y SENSOR	19.0	20.0	18.7	5.1	5.6	4.7
+Y ELECTRONICS	13.3	14.0	13.1	-1.1	-0.4	-1.5
-Y SENSOR	20.4	26.1	18.9	-2.0	2.7	-3.5
-Y ELECTRONICS	13.4	14.2	13.1	-2.3	-1.4	-2.7

The sensitivity of the ESAM to the transient orbital flux levels was slight. The transient analyses indicate that the ESAM structural temperature variation during normal operating conditions is about 1^{o}C. The +Y sensor and electronics packages follow this same temperature variation. The -Y sensor, which receives solar irradiance just before entering the shadow, exhibits a transient variation of about 7^{o}C for the quartz lens case. This is a result of the solar energy which is transmitted through the lens and into the sensor, causing an increase in temperature of this sensor. With the germanium lens, this variation is about 2^{o}C since the lens is opaque to the solar UV flux.

In conclusion, the ESAM thermal design is acceptable for meeting the mission temperature requirements. The design's sensitivity to variations in the orbital flux levels, MMS interface temperature, and supply voltage will not cause the operational limits to be exceeded. Finally, the transient temperature response of the ESAM indicates normal operation within temperature limits.

Doan Eiband

Doan Eiband

Attachments

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APPENDIX C. ESAM THERMAL-BALANCE TEST PREDICTIONS

OAO CORPORATION

M E M O R A N D U M
LDTHER-IOM-81-008
August 26, 1981

5050 Powder Mill Road • Beltsville, Md. 20705
(301) 937-3090

TO : Dave Mengers

FROM : Doan Eiband

SUBJECT: Landsat-D Earth Sensors Assembly Module Thermal Model Predictions for the Thermal-Balance Test

REFERENCE: 1) NASA Goddard Space Flight Center Memorandum, Earth Sensors Assembly Module (ESAM) Thermal-Balance Test Procedure, A. Seivold, June 29, 1981

At the request of the Landsat-D Thermal Engineer, additional computer analyses were made using the Landsat-D Earth Sensors Assembly Module (ESAM) thermal model to predict selected temperatures for the thermal-balance test of the ESAM prototype. Two orbital operational cases were chosen for these analyses. The first case, test 2A of reference 1, has only the +Y sensor operating with the spacecraft in an Earth oriented safehold mode. The second case, test 5B of reference 1, has both sensors operating with the spacecraft in a hot operational mode. Each of these cases was run twice on the computer; once using the computer predicted orbital inputs and once using thermal-balance test inputs which were intended to yield temperatures equivalent to the orbital predictions. These duplicate runs were required to evaluate the equivalence of the orbital and test cases.

Before either of the test cases were run, various modifications were made to the ESAM thermal model to approximate the chamber simulation and to reflect the actual ESAM design configuration. The ESAM model alterations required for the chamber simulation were to recouple all of the ESAM external radiation couplings, except for those of the radiators, to the chamber boundary rather than space. The radiators were not coupled to the chamber since they view an Earth simulator plate which provides a flux level equivalent to the environment that the radiators will see in orbit. The Multi-mission Modular Spacecraft (MMS) radiation couplings to space were also recoupled to the chamber boundary. Finally, the radiator radiation couplings to space were scaled by the ratio of the measured emissivity to the assumed emissivity to give a more accurate value.

Each of the two cases was run once using the orbital parameters and once using the chamber parameters. The general description of these two types of runs is important for comparison of their results. The orbital run computer inputs included the absorbed environmental fluxes on all of the ESAM and MMS surfaces, the appropriate ESAM operational power levels for the sensors and electronics, and a constant MMS interface temperature. The chamber run computer inputs included absorbed environmental fluxes only on the ESAM radiators and ESAM radiation shield, and the appropriate ESAM operatonal powers, MMS interface temperature, and chamber temperature. (The absorbed environmental fluxes were assumed for the radiators in the chamber run since the Earth simulator plate was intended to provide equivalent flux levels.) A test heater was used to apply power equivalent to the estimated absorbed fluxes on the radiation shield. The chamber wall was cooled with LN_2 for the cold 2A test, but was controlled to -50°C for test 5B in an attempt to provide appropriate flux levels to the external surfaces of ESAM.

After completion of the computer runs for the two cases it was found that the initial assumptions concerning the Earth simulation plate were most likely incorrect since the thermal-balance test data showed lower ESAM temperatures than predicted. An analysis of the test set-up geometry pointed to heat losses through the gap around the edges of the plate. An estimate of these losses was made by assuming a view factor of 0.90 between the Earth plate and radiators and then calculating the heat losses through the gap. The test case 2A was rerun using these estimates for the new absorbed environmental fluxes.

The temperature predictions for all of the cases are given in Table 1. The orbital prediction for test 2A yields an average structural temperature of -1.0°C with the chamber prediction 4.0°C cooler. The modified case for the chamber prediction is 7.0°C cooler than the orbital run. The test 5B orbital temperatures yield an average ESAM structural temperature of 17.0°C with a chamber prediction of 1.0°C cooler. A modified case was not run for test 5B.

D. Menges

for Doan Eiband

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Table 1. ESAM Steady State Temperatures (^oC)

Defining Parameters	Orbital Case	TEST 2A Initial Chamber Case	TEST 2A Modified Chamber Case	TEST 5B Orbital Case	TEST 5B Initial Chamber Case
Orbit Beta Angle (Degrees)	23.4	23.4	23.4	41.8	41.8
Supply Voltage (V)	22	22	22	35	35
MMS Temperature (°C)	10	10	10	20	20
Heater Power (W)	None	None	None	None	None
Sensors Operating	+Y Only	+Y Only	+Y Only	Both	Both
Chamber Temperature (°C)	-	-140	-140	-	-50
Component Temperatures					
Radiators	-1.3	-5.6	-8.1	15.7	14.9
+Y Sensor	1.0	-3.2	-5.6	16.8	16.5
+Y Electronics	-0.2	-4.5	-6.9	16.8	15.9
-Y Sensor	-2.1	-6.5	-8.8	17.1	16.6
-Y Electronics	-1.6	-5.9	-8.3	16.8	15.9

APPENDIX D. ESAM AEROHEATING ANALYSIS

OAO CORPORATION

M E M O R A N D U M
LDTHER-IOM-81-003
May 21, 1981

50/50 Powder Mill Road • Beltsville, Md. 20705
(301) 937-3090

TO : Dave Mengers

FROM : Doan Eiband

SUBJECT: Landsat-D Earth Sensor Assembly Module Aeroheating Analysis

REFERENCES:

1. OAO Corporation, Thermal Group Memorandum, LDTHER-IOM-81-001, Landsat-D Earth Sensor Assembly Module Detailed Thermal Model, D. Eiband, May 1981.

2. General Electric Corporation, Environmental Control S/S Engineering, U-1R54-LSD-015, Landsat-D Launch Thermal Analysis, D. Glidden, 2/6/81.

3. International Textbook Company, Principles of Heat Transfer, F. Kreith, 1958.

The purpose of this study was to ascertain the magnitude and direction of the temperature variation of the Landsat-D Earth Sensor Assembly Module (ESAM) from the time of launch on the Delta vehicle until orbital insertion of the spacecraft. This analysis was broken into three separate stages to correspond to the three phases present in the flight. These are as follows:

1. Initial ascent of the vehicle with the fairing on (T=0 through T + 4 minutes)

2. Aeroheating of the spacecraft after fairing jettison (T + 4 through T + 23 minutes)

3. Coast Trajectory until final orbital insertion (T + 23 through T + 74 minutes)

A single node model was used to represent the ESAM structure, sensors, radiators, and electronics. This assumption of a single node was developed after reviewing the results of the thermal analysis done on the 60-node model of reference 1. That study indicated that the predominant heat input and rejection was through the radiators on the +Z surface, and that no significant temperature gradients existed within the ESAM. The only other minor heat input was by conduction through the MMS interface, but since the MMS would probably be at the same temperature as ESAM during

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the launch phases, there would be little, if any, heat exchange by conduction. Consequently, the ESAM single node model had only a radiation coupling to space, equal to that of the radiators to space, and a thermal inertia equal to the sum of the inertias of its components.

Before any temperature calculations were made using the simple model, a comparison of that model to the detailed model was made. This was accomplished by applying the orbital average environmental fluxes on the radiators and solving for the steady state temperature. That temperature was -9°C, while the detailed ESAM model temperature for the corresponding case was -12°C. This comparison of the steady state temperatures shows an adequate correlation between the two models.

In the initial ascent portion of the flight (T=0 through T + 4 minutes), the ESAM was subjected to a radiative heating environment inside the Delta vehicle fairing. The fairing inner wall, an acoustic blanket, was treated as a black cavity surrounding the ESAM and radiating to it. The temperature profile for the blanket was taken from data given in reference 2 for the Landsat-D Delta launch vehicle. Using that temperature profile and assuming an initial ESAM temperature of 21°C, the ESAM temperature rose to 21.5°C during this phase.

In the second portion of the flight following the fairing jettison (T + 4 through T + 23 minutes), the spacecraft experienced aeroheating. During this phase, the spacecraft climbs from an altitude of 70 nm to 110 nm, drops back down to 100 nm, and finally climbs to 150 nm. Concurrent with spacecraft altitude variation is a velocity variation from 10,000 ft/sec at 70 nm, increasing to 19,000 ft/sec at 110 nm, and finally increasing to 26,000 ft/sec at 100 nm. After that, the spacecraft velocity remains relatively constant.

The ESAM aeroheating rates for phase two were calculated using the analytical methods outlined in reference 3 for high speed free molecular flow. This reference indicates that the aeroheating rate is a function of the fluid density, fluid temperature, spacecraft velocity and the geometry of the surface relative to the flow. The first two properties are functions of altitude and were found directly. The spacecraft velocity was given in reference 2, leaving only the selection of appropriate spacecraft geometry. For ESAM, only two kinds of surfaces experience aeroheating: a plate perpendicular to the flow, which represents the insulated +X surface and plates parallel to the flow, which represent the insulated sides and the +Z radiators. It was found that the greatest aeroheating occurs on the +X surface at T + 4 minutes. Even though the +X surface has the highest surface heating rate, only 0.7W of the 34.5W would be transmitted through the insulation blanket in a steady state case. For the remaining surfaces, the heating is much less, with the +Z radiators experiencing their maximum aeroheating of 2.7W at T + 4 minutes and with essentially no heat being transmitted to the sides because of the low heating rate and the insulation.

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The temperature of the ESAM was calculated using the above mentioned aeroheating and the peak orbital environmental fluxes impinging on the radiators. The peak fluxes occur at the point in the Landsat-D orbit just before shadow entry. These values were taken from the β=41.8^{o}, 98.2^{o} inclination orbital flux case calculated using the SSPTA computer program. These aeroheating rates and fluxes were assumed to be constant for the entire 19 minutes of this phase. The resulting temperature rise was from 21.5^{o}C to 22^{o}C using these peak heating levels.

In phase three, the spacecraft was in a coast trajectory from T + 23 minutes until orbital insertion at T + 74 minutes. During this period, the only heating the ESAM experienced was from the absorbed environmental energy since the spacecraft was above the sensible atmosphere where aeroheating would be present. Two orbital cases were considered. The first assumed the peak orbital flux was applied for the entire period and the second assumed the orbital average flux was applied for the period. In both cases there is a net loss of energy from the ESAM, resulting in a temperature decrease. The peak flux case showed a temperature drop from 22^{o}C to 20.5^{o}C during the 51 minute period. The average flux case, on the other hand, resulted in a drop in temperature from 22^{o}C to 16.5^{o}C.

For these analyses, the initial temperature of the ESAM was arbitrarily assumed to be 21^{o}C. The study in reference 2 used an initial temperature of 15^{o}C. The temperature profile for a 15^{o}C initial temperature can be estimated by subtracting 6^{o}C from the results for the 21^{o}C initial temperature since the temperature differences are close enough to assume the same rates of heat transfer. Using this assumption, the orbital average flux case would drop its final temperature to 10.5^{o}C. This temperature approaches the upper control point of the proportional heaters and is based on conservative hot assumptions. If colder conditions exist, the temperature could dip into the heater range. This indicates that the heater circuits should be enabled during launch to protect ESAM in the event the environment is less severe than anticipated.

In summary, the ESAM has a tendency to heat up while it is still in the atmosphere, but will start cooling as soon as frictional effects of the atmosphere have been removed. This study indicates the rise in temperature will be approximately 1 degree from atmospheric heating and the drop in temperature will be about 7 degrees from radiation losses up until orbital insertion. This cooling trend suggests that the ESAM heater circuits be enabled to ensure the protection of the ESAM.

Doan Eiband

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APPENDIX E. DTM DETAILED THERMAL MODEL

M E M O R A N D U M
LDTHER-IOM-81-005
June 9, 1981

OAO CORPORATION

50/50 Pow Mill Road • Beltsville, Md. 20705
(301) 937-3090

TO: D. Mengers

FROM: A. Melak

SUBJECT: Thermal Model Developed for the Dummy Thematic Mapper

REFERENCES:

1. American Society of Mechanical Engineers, 63-WA-196, Controlling Factors of Thermal Conductance Across Bolted Joints in a Vacuum Environment, W. Aron and G. Colombo, November 1963.

2. Arthur D. Little, Inc., C-83198-01, Environmental Flux Study for the Landsat-D Spacecraft, J. T. Bartoszek and W. J. Raymond, March 1980.

The purpose of this memo is to describe the analytical model developed to perform thermal analyses and parametrics on the Landsat-D Dummy Thematic Mapper (DTM). The DTM is an aluminum box, shaped like the Thematic Mapper (TM), to be used if the TM is not completed on schedule. Thermostatically controlled heaters will be placed in the main frame of the DTM in order to simulate the TM's thermal characteristics. The following areas concerning the design will be covered; geometric model, conduction couplings and radiation couplings.

A complete internal and external surface model of the DTM was developed from geometry provided by NASA Goddard. The external model consists of the DTM and all surfaces of the Landsat-D satellite that have a view factor to the DTM, with the exception of the solar array. Since the solar array tracks the sun, a variable geometry would have resulted. How the radiation effects, due to the solar array, were accounted for will be discussed later.

The internal model is comprised of 75 nodes. The majority of the nodes (54) are located in the main frame where the Attitude Determination Sensor Assembly (ADSA), heaters, thermostats, and mounting feet are located; these are the major areas of concern in the analysis. Each of the 6 sides of the main frame was broken into a 3 x 3 grid with the central node of each being 11 inches x 11 inches. The central nodes represent the sections which have had metal removed so that the DTM mass is the same as the TM. The remaining nodes represent the thin aluminum sheet metal which gives the DTM the same dimensions as the TM.

The DTM conductive couplings are based on a thermal conductivity of 204 W/m°C (pure aluminum). The coupling across the joints was calculated using the method described in reference 1 assuming a bolt torque of 75 in·lbs and a rivet tension equal to 1/4 of the ultimate tension (UT = 42,000 psi for 1/8 inch diameter aluminum rivets).

Two additional nodes were created; one for the instrument module (I/M) to which the DTM feet attach and one for the ADSA. The conduction coupling through each of the feet to the I/M is 0.381 BTU/hr°F. The ADSA is mounted to the central node of the Earth facing side of the main frame. The conduction coupling across the ADSA mounting interface is 6 BTU/hr°C.

The internal model is radiatively coupled using an absorptivity of 0.4 and an emissivity of 0.1 (iridite aluminum). The DTM is shrouded with a multilayer insulation with a 2 mil aluminized kapton (α = .42, ε = .75) outer surface. Calculations were performed for insulation effective emittances of 0.02 and 0.01.

In order to account for the radiation effects of the solar array a comparison was made between orbital fluxes calculated for this model without the array and the fluxes published in reference 2 which included the array. The -Y facing surface (solar array side) was determined to be the only one significantly sensitive to the effects of the solar array. This was done by comparing the fluxes per unit area for this model with the fluxes for equivalent orbits and surfaces from the A.D. Little model. The -Y face fluxes were then modified to match the per unit area values from the A.D. Little study.

A listing of the nodes and surface properties is presented in table 1. The radiation and conduction couplings are included in the appendix.

A. Melak

A. Melak

Attachments

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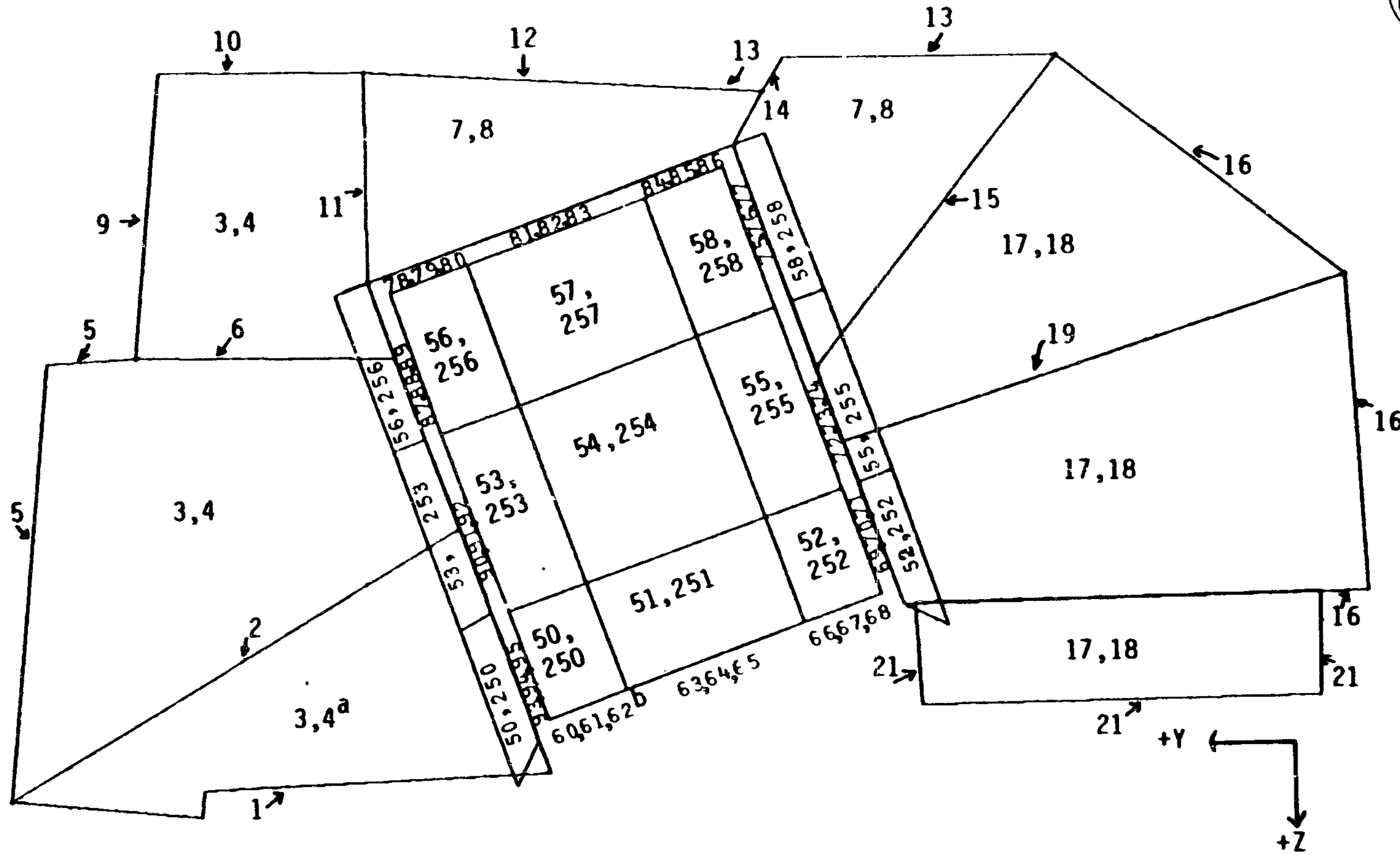
Table 1. DTM Node Descriptions

NODE NUMBER	DESCRIPTION
1-21	Internal nodes of the DTM (depicted in Figure 1) representing the thin aluminum sheeting used to shape the DTM similar to the TM
22	Represents the exterior surface of insulation blanket on the +Z Earth viewing side corresponding to nodes 60-68
50-58	Internal nodes on the -X side of the main frame
60-68	Internal nodes on the +Z side of the main frame
69-77	Internal nodes on the -Y side of the main frame
78-86	Internal nodes on the -Z side of the main frame
87-95	Internal nodes on the +Y side of the main frame
101, 103-105 107-110, 112, 113, 116-118, 121	Exterior surfaces of insulation blankets that correspond to the interior nodes with the same number minus 100 (e.g. node 101 corresponds to node 1)
130, 131	Exterior surfaces of insulation blankets that correspond to interior nodes 50-58 and 250-258
187	Exterior surfaces of Landsat-D satellite that have a view to the DTM
188	Space node
250-258	Internal nodes on the +X side of the main frame
270	ADSA
271	Mission adapter; instrument module



a Two numbers separated by a comma (ex., 3,4) represent parallel surfaces with the first number assigned to the top surface.

b Three numbers separated by commas (ex., 60,61,62) represent three vertical nodes with the first number assigned to the bottom node.

Figure 1. Internal Node Assignments

THEMATIC MAPPER-EXTERNAL SCRIPTF RUN

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RAD    0000      76.541     22     101     0     0     0
GENERATED NODE      22
GENERATED NODE     101
RAD    0000       0.427     22     103     0     0     0
GENERATED NODE     103
RAD    0000       0.119     22     112     0     0     0
GENERATED NODE     112
RAD    0000       2.692     22     117     0     0     0
GENERATED NODE     117
RAD    0000     234.122     22     121     0     0     0
GENERATED NODE     121
RAD    0000       0.211     22     130     0     0     0
GENERATED NODE     130
RAD    0000     374.057     22     187     0     0     0
GENERATED NODE     187
RAD    0001    1825.351     22     188     0     0     0
GENERATED NODE     188
RAD    0000       1.168    101     103     0     0     0
RAD    0000       0.725    101     104     0     0     0
GENERATED NODE     104
RAD    0000       0.120    101     116     0     0     0
GENERATED NODE     116
RAD    0000       0.553    101     117     0     0     0
RAD    0000      15.676    101     121     0     0     0
RAD    0000       0.185    101     130     0     0     0
RAD    0000     135.709    101     187     0     0     0
RAD    0001    3583.411    101     188     0     0     0
RAD    0000       0.452    103     105     0     0     0
GENERATED NODE     105
RAD    0000       0.214    103     107     0     0     0
GENERATED NODE     107
RAD    0000       0.453    103     109     0     0     0
GENERATED NODE     109
RAD    0000       0.356    103     110     0     0     0
GENERATED NODE     110
RAD    0000       1.817    103     112     0     0     0
RAD    0000       1.303    103     113     0     0     0
GENERATED NODE     113
RAD    0000       0.219    103     117     0     0     0
RAD    0000       0.189    103     121     0     0     0
RAD    0000       5.511    103     130     0     0     0
RAD    0000    2021.231    103     187     0     0     0
RAD    0001    2031.527    103     188     0     0     0
RAD    0000       0.150    104     105     0     0     0
RAD    0000       0.313    104     108     0     0     0
GENERATED NODE     108
RAD    0000       0.127    104     110     0     0     0
RAD    0000       0.109    104     116     0     0     0
RAD    0000       1.234    104     118     0     0     0
GENERATED NODE     118
RAD    0000       3.245    104     131     0     0     0
GENERATED NODE     131
RAD    0000     802.435    104     187     0     0     0
RAD    0001    3285.063    104     188     0     0     0
RAD    0000     141.208    105     109     0     0     0
RAD    0000       0.111    105     116     0     0     0
RAD    0000      21.022    105     187     0     0     0
RAD    0001    3308.574    105     188     0     0     0
RAD    0000       3.517    107     110     0     0     0
RAD    0000      21.369    107     112     0     0     0
```

ORIGINAL PAGE IS
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RAD	0000	15.295	107	113	0	0	0
RAD	0000	0.136	107	117	0	0	0
RAD	0000	0.446	107	130	0	0	0
RAD	0000	201.158	107	187	0	0	0
RAD	0001	1384.713	107	188	0	0	0
RAD	0000	0.514	108	118	0	0	0
RAD	0000	1.233	109	131	0	0	0
RAD	0000	55.387	109	187	0	0	0
RAD	0001	1571.615	109	188	0	0	0
RAD	0000	14.099	109	187	0	0	0
RAD	0001	1696.192	109	188	0	0	0
RAD	0000	34.782	110	112	0	0	0
RAD	0000	24 932	110	113	0	0	0
RAD	0000	0.205	110	117	0	0	0
RAD	0000	0.695	110	130	0	0	0
RAD	0000	475.105	110	187	0	0	0
RAD	0001	802.482	110	188	0	0	0
RAD	0000	193.766	112	113	0	0	0
RAD	0000	1.129	112	117	0	0	0
RAD	0000	4.131	112	130	0	0	0
RAD	0000	2100.728	112	187	0	0	0
RAD	0001	43.898	112	188	0	0	0
RAD	0000	0.660	113	116	0	0	0
RAD	0000	0.815	113	117	0	0	0
RAD	0000	2.960	113	130	0	0	0
RAD	0000	1485.882	113	187	0	0	0
RAD	0001	202.711	113	188	0	0	0
RAD	0000	0.222	116	117	0	0	0
RAD	0000	0.146	116	118	0	0	0
RAD	0000	85.684	116	121	0	0	0
RAD	0000	45.943	116	187	0	0	0
RAD	0001	4629.717	116	188	0	0	0
RAD	0000	3.185	117	121	0	0	0
RAD	0000	4.310	117	130	0	0	0
RAD	0000	1801.856	117	187	0	0	0
RAD	0001	2155.330	117	188	0	0	0
RAD	0000	0.634	118	121	0	0	0
RAD	0000	5.120	118	130	0	0	0
RAD	0000	797.946	118	187	0	0	0
RAD	0001	3221.330	118	188	0	0	0
RAD	0000	0.260	121	130	0	0	0
RAD	0000	214.485	121	187	0	0	0
RAD	0001	3407.744	121	188	0	0	0
RAD	0000	354.347	130	187	0	0	0
RAD	0001	2676.300	130	188	0	0	0
RAD	0000	607.550	131	187	0	0	0
RAD	0001	2419.052	131	188	0	0	0
RAD	0001	75352.719	187	188	0	0	0
NODE	0101	188	1.000	0.000			

188 NODE PREVIOUSLY DEFINED. OVERIDES PREVIOUS INPUT.

INTERNAL THEMATIC MAPPER

RAD	0000	165.510	1	2	0	0	0
GENERATED NODE		1					
GENERATED NODE		2					
RAD	0000	52.537	1	3	0	0	0
GENERATED NODE		3					
RAD	0000	52.540	1	[illegible]	0	0	0
GENERATED NODE		4					
RAD	0000	4.305	1	[illegible]	0	0	0
GENERATED NODE		5					
RAD	0000	2.366	1	6	0	0	0
GENERATED NODE		6					
RAD	0000	0.112	1	[illegible]	0	0	0
GENERATED NODE		9					
RAD	0000	3.831	1	[illegible]	0	0	0
GENERATED NODE		50					
RAD	0000	2.087	1	53	0	0	0
GENERATED NODE		53					
RAD	0000	0.216	1	[illegible]	0	0	0
GENERATED NODE		87					
RAD	0000	0.341	1	88	0	0	0
GENERATED NODE		88					
RAD	0000	0.209	1	89	0	0	0
GENERATED NODE		89					
RAD	0000	6.973	1	[illegible]	0	0	0
GENERATED NODE		90					
RAD	0000	12.483	1	[illegible]	0	0	0
GENERATED NODE		91					
RAD	0000	6.973	1	[illegible]	0	0	0
GENERATED NODE		92					
RAD	0000	10.570	1	93	0	0	0
GENERATED NODE		93					
RAD	0000	19.138	1	[illegible]	0	0	0
GENERATED NODE		94					
RAD	0000	10.570	1	[illegible]	0	0	0
GENERATED NODE		95					
RAD	0000	3.831	1	250	0	0	0
GENERATED NODE		250					
RAD	0000	2.090	1	253	0	0	0
GENERATED NODE		253					
RAD	0000	111.198	2	[illegible]	0	0	0
RAD	0000	111.232	2	4	0	0	0
RAD	0000	116.791	2	[illegible]	0	0	0
RAD	0000	58.834	2	[illegible]	0	0	0
RAD	0000	2.489	2	9	0	0	0
RAD	0000	1.754	2	[illegible]	[illegible]	0	0
GENERATED NODE		10					
RAD	0000	1.730	2	[illegible]	[illegible]	0	[illegible]
GENERATED NODE		11					
RAD	0000	3.333	2	[illegible]	[illegible]	0	0
RAD	0000	3.876	2	[illegible]	0	0	0
RAD	0000	1.737	2	[illegible]	0	0	0
GENERATED NODE		56					
RAD	0000	4.931	2	[illegible]	0	0	0
RAD	0000	8.799	2	[illegible]	0	0	0
RAD	0000	4.835	2	[illegible]	0	0	0
RAD	0000	11.715	2	[illegible]	0	0	0
RAD	0000	21.088	2	[illegible]	[illegible]	0	0
RAD	0000	11.715	2	[illegible]	[illegible]	0	0
RAD	0000	9.353	2	[illegible]	0	0	[illegible]
RAD	0000	16.901	2	[illegible]	0	0	0

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RAD	0000	9. 353	2	[illegible]	0	0	0
RAD	0000	3. 333	2	250	0	0	0
RAD	0000	3. 879	2	253	0	0	0
RAD	0000	1. 726	2	[illegible]	0	0	0
GENERATED NODE		256					
RAD	0000	67. 810	3	4	0	0	0
RAD	0000	65. 809	3	5	0	0	0
RAD	0000	59. [illegible]	3	6	0	0	0
RAD	0000	29. 134	3	[illegible]	0	0	0
RAD	0000	21. 251	3	[illegible]	0	0	0
RAD	0000	21. 679	3	11	0	0	0
RAD	0000	1. 125	3	[illegible]	0	0	0
RAD	0000	1. 687	3	[illegible]	0	0	0
RAD	0000	1. 497	3	[illegible]	0	0	0
RAD	0000	5. 402	3	[illegible]	0	0	0
RAD	0000	8 569	3	[illegible]	0	0	0
RAD	0000	4 639	3	90	0	0	0
RAD	0000	5 788	3	[illegible]	0	0	0
RAD	0000	9 117	3	[illegible]	0	0	0
RAD	0000	4. 924	3	[illegible]	0	0	0
RAD	0000	3. 753	3	[illegible]	0	0	0
RAD	0000	5. 631	3	94	0	0	0
RAD	0000	3. 019	3	95	0	0	0
RAD	0000	1. 136	3	250	0	0	0
RAD	0000	1. 741	3	253	0	0	0
RAD	0000	1. 546	3	[illegible]	0	0	0
RAD	0000	65. 891	4	5	0	0	0
RAD	0000	59. [illegible]	4	6	0	0	0
RAD	0000	29. 063	4	9	0	0	0
RAD	0000	21. 201	4	[illegible]	0	0	0
RAD	0000	21. 629	4	[illegible]	0	0	0
RAD	0000	1. 136	4	[illegible]	0	0	0
RAD	0000	1. 743	4	[illegible]	0	0	0
RAD	0000	1. 5[illegible]7	4	[illegible]	0	0	0
RAD	0000	4. 646	4	[illegible]	0	0	0
RAD	0000	8 563	4	[illegible]	0	0	0
RAD	0000	5. 426	4	89	0	0	0
RAD	0000	4 [illegible]28	4	[illegible]	0	0	0
RAD	0000	9 124	4	[illegible]	0	0	0
RAD	0000	5. [illegible]92	4	[illegible]	0	0	0
RAD	0000	3 [illegible]20	4	[illegible]	0	0	0
RAD	0000	5. 631	4	[illegible]	0	0	0
RAD	0000	3. 753	4	[illegible]	0	0	0
RAD	0000	1. 126	4	250	0	0	0
RAD	0000	1. 688	4	253	0	0	0
RAD	0000	1. 500	4	256	0	0	0
RAD	0000	54. 005	5	4	0	0	0
RAD	0000	2. 335	5	[illegible]	0	0	0
RAD	0000	1. 645	5	[illegible]	0	0	0
RAD	0000	1. 623	5	[illegible]	0	0	0
RAD	0000	1. 848	5	[illegible]	0	0	0
RAD	0000	1. 627	5	[illegible]	0	0	0
RAD	0000	4. 789	5	[illegible]	0	0	0
RAD	0000	8. 587	5	[illegible]	0	0	0
RAD	0000	4 698	5	[illegible]	0	0	0
RAD	0000	5. 292	5	[illegible]	0	0	0
RAD	0000	9 302	5	[illegible]	0	0	0
RAD	0000	5. 232	5	[illegible]	0	0	0
RAD	0000	0 279	5	[illegible]	0	0	0
RAD	0000	0. 450	5	[illegible]	0	0	0
RAD	0000	0. 279	5	[illegible]	0	0	0

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RAD	0000	1.849	5	253	0	0	0
RAD	0000	1.617	5	255	0	0	0
RAD	0000	47.243	6	9	0	0	0
RAD	0000	34.143	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	33.673	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.017	6	[illegible]	[illegible]	0	0
RAD	0000	1.998	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	6.482	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	11.665	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	6.518	[illegible]	89	[illegible]	0	0
RAD	0000	2.723	6	90	[illegible]	0	0
RAD	0000	4.858	6	[illegible]	[illegible]	0	0
RAD	0000	2.723	[illegible]	92	0	0	0
RAD	0000	0.154	5	93	[illegible]	0	0
RAD	0000	0.247	[illegible]	94	[illegible]	0	0
RAD	0000	0.154	6	[illegible]	[illegible]	0	0
RAD	0000	1.015	6	253	0	0	0
RAD	0000	2.002	6	256	[illegible]	0	0
RAD	0000	20.158	7	8	0	0	0
GENERATED NODE		7					
GENERATED NODE		8					
RAD	0000	17.596		[illegible]	0	0	0
RAD	0000	32.776	7	12	0	0	0
GENERATED NODE		12					
RAD	0000	27.024	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		13					
RAD	0000	5.115	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		14					
RAD	0000	34.439	[illegible]	15	[illegible]	0	0
GENERATED NODE		15					
RAD	0000	0.817	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		16					
RAD	0000	0.581	[illegible]	[illegible]	0	0	0
GENERATED NODE		17					
RAD	0000	0.581	7	[illegible]	0	0	0
GENERATED NODE		18					
RAD	0000	1.337	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		19					
RAD	0000	0.314	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		20					
RAD	0000	0.412	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		55					
RAD	0000	1.154	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		58					
RAD	0000	1.755	7	72	[illegible]	0	0
GENERATED NODE		72					
RAD	0000	2.742	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		73					
RAD	0000	1.488	[illegible]	74	[illegible]	0	0
GENERATED NODE		74					
RAD	0000	4.476	[illegible]	75	[illegible]	0	0
GENERATED NODE		75					
RAD	0000	6.526	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		76					
RAD	0000	3.453	[illegible]	[illegible]	0	0	0
GENERATED NODE		77					
RAD	0000	2.507	[illegible]	[illegible]	0	0	0
GENERATED NODE		78					
RAD	0000	3.643	[illegible]	[illegible]	0	0	0
GENERATED NODE		79					
RAD	0000	1.783	[illegible]	[illegible]	0	0	0

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GENERATED NODE		80					
RAD	0000	5.067		[illegible]	0	0	0
GENERATED NODE		81					
RAD	0000	7.152		[illegible]	0	0	0
GENERATED NODE		82					
RAD	0000	3.810	7	[illegible]	0	0	0
GENERATED NODE		83					
RAD	0000	2.523		[illegible]	0	0	0
GENERATED NODE		84					
RAD	0000	3.707		[illegible]	0	0	0
GENERATED NODE		85					
RAD	0000	1.999		[illegible]	0	0	[illegible]
GENERATED NODE		86					
RAD	0000	0.416		235	[illegible]	0	0
GENERATED NODE		255					
RAD	0000	1.137		258	[illegible]	0	[illegible]
GENERATED NODE		258					
RAD	0000	17.596	8	11	[illegible]	0	[illegible]
RAD	0000	32.976	8	[illegible]	[illegible]	0	0
RAD	0000	27.024	[illegible]	13	[illegible]	0	0
RAD	0000	5.115	8	[illegible]	[illegible]	0	0
RAD	0000	34.439	[illegible]	15	[illegible]	0	0
RAD	0000	0.817	8	[illegible]	[illegible]	0	0
RAD	0000	0.581	8	[illegible]	[illegible]	0	0
RAD	0000	0.581	[illegible]	16	[illegible]	0	[illegible]
RAD	0000	1.337	8	[illegible]	0	0	0
RAD	0000	0.314	[illegible]	[illegible]	0	0	0
RAD	0000	0.416	8	55	0	0	[illegible]
RAD	0000	1.136	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.488	8	[illegible]	0	0	0
RAD	0000	2.742	8	[illegible]	0	0	0
RAD	0000	1.755	8	74	[illegible]	0	0
RAD	0000	3.453	[illegible]	75	[illegible]	0	[illegible]
RAD	0000	6.526	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	4.476	[illegible]	[illegible]	0	0	0
RAD	0000	1.983	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	3.643	9	[illegible]	0	0	[illegible]
RAD	0000	2.507	[illegible]	80	0	0	0
RAD	0000	3.810	[illegible]	[illegible]	0	0	0
RAD	0000	7.152	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	5.067	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.999	[illegible]	[illegible]	0	0	0
RAD	0000	3.707	8	[illegible]	[illegible]	0	0
RAD	0000	2.523	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.413	8	[illegible]	[illegible]	0	0
RAD	0000	1.154	[illegible]	[illegible]	0	0	0
RAD	0000	36.875	9	[illegible]	[illegible]	0	0
RAD	0000	38.856	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.978	9	[illegible]	[illegible]	0	0
RAD	0000	3.685	9	[illegible]	[illegible]	0	0
RAD	0000	6.673	9	[illegible]	[illegible]	0	0
RAD	0000	3.765	9	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.127	[illegible]	90	[illegible]	0	0
RAD	0000	0.203	9	[illegible]	[illegible]	0	0
RAD	0000	0.127	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.986	9	256	0	0	0
RAD	0000	28.355	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.639	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	2.477	10	[illegible]	[illegible]	0	0
RAD	0000	4.413	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	2.534	[illegible]	[illegible]	[illegible]	0	0

RAD	0000	0.143	10	[illegible]	0	0	0
RAD	0000	0.695	10	256	0	0	0
RAD	0000	55.902	11	12	0	0	0
RAD	0000	8.312	11	[illegible]	0	0	0
RAD	0000	0.681	11	[illegible]	0	0	0
RAD	0000	3.470	11	[illegible]	0	0	0
RAD	0000	6.123	11	[illegible]	0	0	0
RAD	0000	3.470	11	80	0	0	0
RAD	0000	7.101	11	81	0	0	0
RAD	0000	12.760	11	[illegible]	0	0	0
RAD	0000	7.101	11	83	0	0	0
RAD	0000	4.338	11	84	0	0	0
RAD	0000	7.892	11	[illegible]	0	0	0
RAD	0000	4.338	11	[illegible]	0	0	0
RAD	0000	2.467	11	[illegible]	0	0	0
RAD	0000	4.391	11	[illegible]	0	0	0
RAD	0000	2.524	11	89	0	0	0
RAD	0000	0.145	11	[illegible]	0	0	0
RAD	0000	0.686	11	255	0	0	0
RAD	0000	18.159	12	[illegible]	0	0	0
RAD	0000	7.633	12	[illegible]	0	0	0
RAD	0000	13.927	12	79	0	0	0
RAD	0000	7.633	12	[illegible]	0	0	0
RAD	0000	14.056	12	91	0	0	0
RAD	0000	25.604	12	92	0	0	0
RAD	0000	14.056	12	[illegible]	0	0	0
RAD	0000	6.895	12	94	0	0	0
RAD	0000	12.368	12	[illegible]	0	0	0
RAD	0000	6.894	12	86	0	0	0
RAD	0000	88.607	13	15	0	0	0
RAD	0000	2.033	13	[illegible]	0	0	0
RAD	0000	1.446	13	[illegible]	0	0	0
RAD	0000	1.446	13	[illegible]	0	0	0
RAD	0000	3.328	13	[illegible]	0	0	0
RAD	0000	0.780	13	20	0	0	0
RAD	0000	1.029	13	53	0	0	0
RAD	0000	2.841	13	59	0	0	0
RAD	0000	3.988	13	[illegible]	0	0	0
RAD	0000	6.986	13	[illegible]	0	0	0
RAD	0000	3.888	13	74	0	0	0
RAD	0000	9.237	13	75	0	0	0
RAD	0000	16.752	13	[illegible]	0	0	0
RAD	0000	9.237	13	[illegible]	0	0	0
RAD	0000	1.029	13	[illegible]	0	0	0
RAD	0000	2.841	13	258	0	0	0
RAD	0000	1.147	14	78	0	0	0
RAD	0000	2.066	14	[illegible]	0	0	0
RAD	0000	1.147	14	80	0	0	0
RAD	0000	2.006	14	81	0	0	0
RAD	0000	3.582	14	[illegible]	0	0	0
RAD	0000	2.006	14	[illegible]	0	0	0
RAD	0000	1.010	14	84	0	0	0
RAD	0000	-1.786	14	[illegible]	0	0	0
RAD	0000	1.010	14	86	0	0	0
RAD	0000	69.598	15	[illegible]	0	0	0
RAD	0000	44.293	15	[illegible]	0	0	0
RAD	0000	44.293	15	[illegible]	0	0	0
RAD	0000	105.832	15	[illegible]	0	0	0
RAD	0000	2.189	15	20	0	0	0
RAD	0000	2.586	15	53	0	0	0
RAD	0000	3.739	15	59	0	0	0

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RAD	0000	0.180	15	69	0	0	0
GENERATED NODE		69					
RAD	0000	0.276	15	70	0	0	0
GENERATED NODE		70					
RAD	0000	0.180	15	71	0	0	0
GENERATED NODE		71					
RAD	0000	9.215	15	72	0	0	0
RAD	0000	16.561	15	[illegible]	0	0	0
RAD	0000	9.215	15	74	0	0	0
RAD	0000	12.060	15	75	0	0	0
RAD	0000	21.931	15	76	0	0	0
RAD	0000	12.060	15	[illegible]	0	0	0
RAD	0000	2.886	15	253	0	0	0
RAD	0000	3.739	15	255	0	0	0
RAD	0000	77.680	16	17	0	0	0
RAD	0000	77.680	16	[illegible]	0	0	0
RAD	0000	164.067	16	19	0	0	0
RAD	0000	52.140	16	20	0	0	0
RAD	0000	0.856	16	21	0	0	0
GENERATED NODE		21					
RAD	0000	1.424	16	52	0	0	0
GENERATED NODE		52					
RAD	0000	1.694	16	55	0	0	0
RAD	0000	4.404	16	67	0	0	0
RAD	0000	7.917	16	70	0	0	0
RAD	0000	4.404	16	71	0	0	0
RAD	0000	5.057	16	72	0	0	0
RAD	0000	9.006	16	73	0	0	0
RAD	0000	5.057	16	74	0	0	0
RAD	0000	0.290	16	75	0	0	0
RAD	0000	0.486	16	76	0	0	0
RAD	0000	0.290	16	77	0	0	0
RAD	0000	1.424	16	252	0	0	0
GENERATED NODE		252					
RAD	0000	1.694	16	255	0	0	0
RAD	0000	66.598	17	[illegible]	0	0	0
RAD	0000	121.235	17	19	0	0	0
RAD	0000	87.056	17	20	0	0	0
RAD	0000	44.764	17	21	0	0	0
RAD	0000	1.391	17	52	0	0	0
RAD	0000	1.136	17	55	0	0	0
RAD	0000	4.593	17	67	0	0	0
RAD	0000	7.350	17	70	0	0	0
RAD	0000	3.971	17	71	0	0	0
RAD	0000	3.996	17	72	0	0	0
RAD	0000	6.410	17	73	0	0	0
RAD	0000	3.510	17	74	0	0	0
RAD	0000	0.206	17	75	0	0	0
RAD	0000	0.346	17	76	0	0	0
RAD	0000	0.206	17	[illegible]	0	0	0
RAD	0000	1.432	17	252	0	0	0
RAD	0000	1.222	17	255	0	0	0
RAD	0000	121.235	18	19	0	0	0
RAD	0000	87.056	18	20	0	0	0
RAD	0000	44.764	18	21	0	0	0
RAD	0000	1.432	18	[illegible]	0	0	0
RAD	0000	1.222	18	55	0	0	0
RAD	0000	3.971	18	67	0	0	0
RAD	0000	7.350	18	70	0	0	0
RAD	0000	4.593	18	71	0	0	0
RAD	0000	3.510	18	72	0	0	0

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RAD	0000	6.410	18	73	0	0	[illegible]
RAD	0000	3.996	18	74	0	0	[illegible]
RAD	0000	0.206	18	75	0	0	[illegible]
RAD	0000	0.345	18	[illegible]	0	0	0
RAD	0000	0.206	18	[illegible]	0	0	0
RAD	0000	1.391	18	252	0	0	[illegible]
RAD	0000	1.186	18	255	0	0	0
RAD	0000	106.636	19	20	0	0	[illegible]
RAD	0000	1.511	19	21	0	0	0
RAD	0000	2.514	19	52	[illegible]	0	0
RAD	0000	2.772	19	55	0	0	0
RAD	0000	0.148	19	69	[illegible]	0	0
RAD	0000	7.491	19	[illegible]	[illegible]	0	0
RAD	0000	13.585	19	[illegible]	[illegible]	0	0
RAD	0000	7.491	19	[illegible]	[illegible]	0	0
RAD	0000	8.051	19	[illegible]	0	0	0
RAD	0000	14.380	19	73	0	0	0
RAD	0000	8.051	19	74	[illegible]	0	0
RAD	0000	0.474	19	75	[illegible]	0	0
RAD	0000	0.796	19	76	[illegible]	0	0
RAD	0000	0.474	19	77	[illegible]	0	0
RAD	0000	2.514	19	252	0	0	0
RAD	0000	2.772	19	255	0	0	0
RAD	0000	0.148	19	258	0	0	0
RAD	0000	133.475	20	21	0	0	[illegible]
RAD	0000	2.474	20	52	0	0	0
RAD	0000	0.650	20	55	[illegible]	0	0
RAD	0000	6.565	20	69	[illegible]	0	[illegible]
RAD	0000	11.740	20	70	[illegible]	0	0
RAD	0000	6.565	20	71	[illegible]	0	0
RAD	0000	2.250	20	72	[illegible]	0	0
RAD	0000	3.972	20	73	0	0	[illegible]
RAD	0000	2.250	20	74	0	0	0
RAD	0000	0.111	20	75	0	0	[illegible]
RAD	0000	0.187	20	[illegible]	0	0	0
RAD	0000	0.111	20	[illegible]	[illegible]	0	0
RAD	0000	2.474	20	252	[illegible]	0	0
RAD	0000	0.650	20	255	[illegible]	0	[illegible]
RAD	0000	0.408	21	52	[illegible]	0	0
RAD	0000	0.186	21	69	[illegible]	0	0
RAD	0000	0.165	21	70	[illegible]	0	0
RAD	0000	0.186	21	71	[illegible]	0	0
RAD	0000	0.408	21	252	0	0	0
RAD	0000	0.460	50	51	[illegible]	0	0
GENERATED NODE		51					
RAD	0000	0.167	50	52	[illegible]	0	0
RAD	0000	0.363	50	53	[illegible]	0	0
RAD	0000	0.677	50	54	[illegible]	0	0
GENERATED NODE		54					
RAD	0000	0.277	50	55	[illegible]	0	[illegible]
RAD	0000	0.203	50	56	[illegible]	0	0
RAD	0000	0.477	50	[illegible]	[illegible]	0	[illegible]
GENERATED NODE		57					
RAD	0000	0.201	50	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.622	50	[illegible]	[illegible]	0	0
GENERATED NODE		60					
RAD	0000	0.374	50	[illegible]	[illegible]	0	0
GENERATED NODE		61					
RAD	0000	0.164	50	62	[illegible]	0	0
GENERATED NODE		62					
RAD	0000	0.512	50	63	[illegible]	0	0

GENERATED NODE		63					
RAD	0000	0. 734	[illegible]	[illegible]	[illegible]	0	0
GENERATED NODE		64					
RAD	0000	0. 378	50	55	0	0	[illegible]
GENERATED NODE		65					
RAD	0000	0. 159	[illegible]	[illegible]	0	0	0
GENERATED NODE		66					
RAD	0000	0. 286	[illegible]	[illegible]	0	0	0
GENERATED NODE		67					
RAD	0000	0. 158	[illegible]	69	[illegible]	0	0
GENERATED NODE		68					
RAD	0000	[illegible]	50	[illegible]	[illegible]	0	0
RAD	0000	0. 3	50	[illegible]	[illegible]	0	0
RAD	0000	0. 235	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 396	50	72	[illegible]	0	[illegible]
RAD	0000	0. 724	[illegible]	73	[illegible]	0	[illegible]
RAD	0000	0. 392	[illegible]	74	[illegible]	0	0
RAD	0000	0. 276	[illegible]	75	[illegible]	0	0
RAD	0000	0. 507	[illegible]	76	[illegible]	0	0
RAD	0000	0. 282	50	[illegible]	[illegible]	0	0
RAD	0000	0. 155	50	78	0	0	[illegible]
RAD	0000	0. 286	[illegible]	79	0	0	0
RAD	0000	0. 159	[illegible]	80	[illegible]	0	0
RAD	0000	0. 373	[illegible]	81	[illegible]	0	0
RAD	0000	0. 689	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0. 381	50	83	[illegible]	0	0
RAD	0000	0. 158	[illegible]	84	0	0	0
RAD	0000	0. 274	50	85	[illegible]	0	[illegible]
RAD	0000	0. 162	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 270	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 491	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 276	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0. 637	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 757	50	[illegible]	[illegible]	0	0
RAD	0000	0. 516	50	[illegible]	[illegible]	0	[illegible]
RAD	0000	1. 378	50	[illegible]	0	0	[illegible]
RAD	0000	0. 893	50	[illegible]	0	0	[illegible]
RAD	0000	0. 442	[illegible]	[illegible]	0	0	0
RAD	0000	0. 286	50	250	0	0	0
RAD	0000	0. 450	[illegible]	251	[illegible]	0	0
GENERATED NODE		251					
RAD	0000	0. 180	50	252	0	0	0
RAD	0000	0. 370	[illegible]	253	[illegible]	0	0
RAD	0000	0. 736	[illegible]	254	0	0	0
GENERATED NODE		254					
RAD	0000	0. 300	50	255	0	0	0
RAD	0000	0. 223	[illegible]	256	0	0	0
RAD	0000	0. 517	50	[illegible]	[illegible]	0	0
GENERATED NODE		257					
RAD	0000	0. 215	[illegible]	258	0	0	[illegible]
RAD	0000	0. 460	[illegible]	52	0	0	0
RAD	0000	0. 682	51	53	0	0	[illegible]
RAD	0000	1. 595	[illegible]	[illegible]	0	0	0
RAD	0000	0. 683	[illegible]	55	0	0	0
RAD	0000	0. 478	51	[illegible]	[illegible]	0	0
RAD	0000	1. 134	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 479	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0. 512	51	[illegible]	[illegible]	0	[illegible]
RAD	0000	0. 754	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0. 336	[illegible]	62	0	0	[illegible]
RAD	0000	1. 960	[illegible]	63	[illegible]	0	[illegible]

RAD	0000	1.825	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.707	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.512	[illegible]	66	[illegible]	0	0
RAD	0000	0.754	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.386	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.740	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.152	[illegible]	70	[illegible]	0	0
RAD	0000	0.559	[illegible]	71	[illegible]	0	0
RAD	0000	0.993	[illegible]	72	0	0	[illegible]
RAD	0000	1.757	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.925	51	74	0	0	0
RAD	0000	0.643	[illegible]	75	[illegible]	0	0
RAD	0000	1.187	[illegible]	76	0	0	0
RAD	0000	0.661	51	[illegible]	[illegible]	0	0
RAD	0000	0.368	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.687	51	[illegible]	[illegible]	0	0
RAD	0000	0.381	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.879	51	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.634	[illegible]	92	[illegible]	0	[illegible]
RAD	0000	0.906	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.368	[illegible]	[illegible]	0	0	0
RAD	0000	0.687	51	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.381	51	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.643	[illegible]	97	0	0	0
RAD	0000	1.188	[illegible]	99	0	0	0
RAD	0000	0.661	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.993	51	[illegible]	0	0	[illegible]
RAD	0000	1.757	[illegible]	[illegible]	0	0	0
RAD	0000	0.925	51	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.740	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.152	[illegible]	94	[illegible]	0	0
RAD	0000	0.559	51	[illegible]	[illegible]	0	0
RAD	0000	0.451	51	250	[illegible]	0	[illegible]
RAD	0000	1.081	[illegible]	251	0	0	0
RAD	0000	0.451	[illegible]	252	0	0	0
RAD	0000	0.740	[illegible]	[illegible]	0	0	0
RAD	0000	1.762	[illegible]	254	0	0	0
RAD	0000	0.740	[illegible]	255	[illegible]	0	0
RAD	0000	0.518	51	256	[illegible]	0	0
RAD	0000	1.230	[illegible]	257	[illegible]	0	0
RAD	0000	0.518	[illegible]	258	0	0	0
RAD	0000	0.277	52	[illegible]	[illegible]	0	0
RAD	0000	0.677	52	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.336	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.201	52	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.477	[illegible]	[illegible]	0	0	0
RAD	0000	0.203	52	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.159	[illegible]	60	[illegible]	0	0
RAD	0000	0.286	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.158	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.513	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.735	52	64	[illegible]	0	[illegible]
RAD	0000	0.378	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.623	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.374	52	[illegible]	[illegible]	0	0
RAD	0000	0.164	52	[illegible]	[illegible]	0	0
RAD	0000	1.300	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.769	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.372	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.544	52	[illegible]	[illegible]	0	0
RAD	0000	0.795	52	[illegible]	[illegible]	0	0

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RAD	0000	0.425	52	74	0	0	0
RAD	0000	0.266	52	75	0	0	0
RAD	0000	0.489	52	76	0	0	0
RAD	0000	0.274	52	77	0	0	0
RAD	0000	0.158	52	78	0	0	0
RAD	0000	0.294	52	[illegible]	0	0	0
RAD	0000	0.162	52	80	0	0	0
RAD	0000	0.373	52	81	0	0	0
RAD	0000	0.688	52	82	0	0	0
RAD	0000	0.381	52	83	0	0	0
RAD	0000	0.155	52	84	0	0	0
RAD	0000	0.285	52	[illegible]	0	0	0
RAD	0000	0.159	52	86	0	0	0
RAD	0000	0.276	52	[illegible]	0	0	0
RAD	0000	0.508	52	88	0	0	0
RAD	0000	0.282	52	89	0	0	0
RAD	0000	0.397	52	90	0	0	0
RAD	0000	0.724	52	91	0	0	0
RAD	0000	0.393	52	92	0	0	0
RAD	0000	0.243	52	93	0	0	0
RAD	0000	0.443	52	94	0	0	0
RAD	0000	0.235	52	[illegible]	0	0	0
RAD	0000	0.180	52	250	0	0	0
RAD	0000	0.451	52	251	0	0	0
RAD	0000	0.256	52	252	0	0	0
RAD	0000	0.301	52	253	0	0	0
RAD	0000	0.737	52	254	0	0	0
RAD	0000	0.339	52	255	0	0	0
RAD	0000	0.215	52	256	0	0	0
RAD	0000	0.517	52	257	0	0	0
RAD	0000	0.222	52	258	0	0	0
RAD	0000	1.182	[illegible]	[illegible]	0	0	0
RAD	0000	0.479	53	55	0	0	0
RAD	0000	0.427	[illegible]	[illegible]	0	0	0
RAD	0000	0.873	[illegible]	[illegible]	0	0	0
RAD	0000	0.359	[illegible]	59	0	0	0
RAD	0000	0.351	[illegible]	60	0	0	0
RAD	0000	0.585	[illegible]	61	0	0	0
RAD	0000	0.292	53	62	0	0	0
RAD	0000	0.716	[illegible]	63	0	0	0
RAD	0000	1.282	53	64	0	0	0
RAD	0000	0.676	[illegible]	[illegible]	0	0	0
RAD	0000	0.273	53	66	0	0	0
RAD	0000	0.506	[illegible]	[illegible]	0	0	0
RAD	0000	0.279	53	[illegible]	0	0	0
RAD	0000	0.388	[illegible]	[illegible]	0	0	0
RAD	0000	0.722	53	[illegible]	0	0	0
RAD	0000	0.393	53	71	0	0	0
RAD	0000	0.683	[illegible]	72	0	0	0
RAD	0000	1.255	[illegible]	[illegible]	0	0	0
RAD	0000	0.685	53	[illegible]	0	0	0
RAD	0000	0.502	[illegible]	75	0	0	0
RAD	0000	0.933	53	[illegible]	0	0	0
RAD	0000	0.511	[illegible]	[illegible]	0	0	0
RAD	0000	0.273	[illegible]	[illegible]	0	0	0
RAD	0000	0.506	[illegible]	79	0	0	0
RAD	0000	0.280	53	[illegible]	0	0	0
RAD	0000	0.570	53	[illegible]	0	0	0
RAD	0000	1.261	[illegible]	92	0	0	0
RAD	0000	0.677	[illegible]	[illegible]	0	0	0
RAD	0000	0.319	53	94	0	0	0

RAD	0000	0.564	33	[illegible]	[illegible]	0	0
RAD	0000	0.291	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.675	33	[illegible]	0	0	0
RAD	0000	1.061	[illegible]	[illegible]	0	0	0
RAD	0000	0.571	53	[illegible]	0	0	0
RAD	0000	2.155	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.588	53	[illegible]	[illegible]	0	0
RAD	0000	0.816	53	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.621	53	[illegible]	0	0	0
RAD	0000	0.937	33	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.900	53	95	[illegible]	0	0
RAD	0000	0.369	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.739	[illegible]	251	[illegible]	0	0
RAD	0000	0.300	[illegible]	252	[illegible]	0	[illegible]
RAD	0000	0.627	[illegible]	253	[illegible]	0	0
RAD	0000	1.291	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.524	[illegible]	255	[illegible]	0	[illegible]
RAD	0000	0.446	53	[illegible]	[illegible]	0	0
RAD	0000	0.955	53	257	0	0	0
RAD	0000	0.390	[illegible]	258	0	0	[illegible]
RAD	0000	1.184	54	55	0	0	[illegible]
RAD	0000	0.869	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	2.043	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.870	54	[illegible]	[illegible]	0	0
RAD	0000	0.698	54	[illegible]	[illegible]	0	0
RAD	0000	1.284	54	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.679	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.727	54	63	[illegible]	0	[illegible]
RAD	0000	3.100	[illegible]	64	[illegible]	0	0
RAD	0000	1.617	54	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.698	54	[illegible]	[illegible]	0	0
RAD	0000	1.284	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.679	54	[illegible]	[illegible]	0	0
RAD	0000	0.968	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.760	54	70	[illegible]	0	0
RAD	0000	0.930	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.849	54	72	[illegible]	0	0
RAD	0000	3.156	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.619	54	[illegible]	0	0	[illegible]
RAD	0000	1.230	[illegible]	73	[illegible]	0	[illegible]
RAD	0000	2.253	[illegible]	74	[illegible]	0	0
RAD	0000	1.207	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.674	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.261	[illegible]	[illegible]	0	0	0
RAD	0000	0.678	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.632	[illegible]	[illegible]	0	0	0
RAD	0000	3.021	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.611	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.674	54	94	0	0	0
RAD	0000	1.260	[illegible]	95	0	0	0
RAD	0000	0.677	54	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.230	54	[illegible]	[illegible]	0	0
RAD	0000	2.253	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.207	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.848	54	[illegible]	[illegible]	0	0
RAD	0000	3.156	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.619	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.968	54	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.760	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.930	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.737	54	250	[illegible]	0	0

ORIGINAL PAGE IS OF POOR QUALITY

RAD	0000	1.762	54	251	[illegible]	0	0
RAD	0000	0.737	[illegible]	[illegible]	0	0	0
RAD	0000	1.292	54	233	0	0	[illegible]
RAD	0000	3.086	[illegible]	254	[illegible]	0	0
RAD	0000	1.292	[illegible]	255	[illegible]	0	0
RAD	0000	0.954	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	2.277	34	257	[illegible]	0	0
RAD	0000	0.954	[illegible]	258	[illegible]	0	0
RAD	0000	0.360	55	[illegible]	0	0	0
RAD	0000	0.875	55	[illegible]	0	0	0
RAD	0000	0.441	55	[illegible]	0	0	0
RAD	0000	0.274	55	[illegible]	0	0	0
RAD	0000	0.507	55	[illegible]	0	0	0
RAD	0000	0.279	[illegible]	62	[illegible]	0	0
RAD	0000	0.717	55	[illegible]	[illegible]	0	0
RAD	0000	1.284	[illegible]	64	0	0	0
RAD	0000	0.677	55	[illegible]	0	0	0
RAD	0000	0.352	[illegible]	[illegible]	0	0	0
RAD	0000	0.586	55	[illegible]	[illegible]	0	0
RAD	0000	0.292	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.533	[illegible]	69	0	0	0
RAD	0000	0.802	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.425	55	[illegible]	[illegible]	0	[illegible]
RAD	0000	2.129	[illegible]	72	0	0	0
RAD	0000	1.552	55	[illegible]	0	0	[illegible]
RAD	0000	0.797	55	[illegible]	0	0	0
RAD	0000	0.728	55	75	[illegible]	0	[illegible]
RAD	0000	1.162	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.629	55	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.318	55	[illegible]	0	0	0
RAD	0000	0.563	55	[illegible]	[illegible]	0	0
RAD	0000	0.291	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.689	55	[illegible]	[illegible]	0	0
RAD	0000	1.239	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.676	[illegible]	[illegible]	0	0	0
RAD	0000	0.272	[illegible]	84	0	0	0
RAD	0000	0.505	55	[illegible]	0	0	0
RAD	0000	0.279	[illegible]	[illegible]	0	0	0
RAD	0000	0.503	55	[illegible]	0	0	[illegible]
RAD	0000	0.935	[illegible]	88	0	0	0
RAD	0000	0.512	[illegible]	89	0	0	[illegible]
RAD	0000	0.684	55	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.266	55	[illegible]	[illegible]	0	0
RAD	0000	0.686	55	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.389	55	[illegible]	0	0	0
RAD	0000	0.723	[illegible]	94	[illegible]	0	0
RAD	0000	0.394	55	[illegible]	0	0	0
RAD	0000	0.301	55	250	[illegible]	0	0
RAD	0000	0.740	55	[illegible]	0	0	0
RAD	0000	0.339	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.524	55	[illegible]	0	0	0
RAD	0000	1.292	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.618	55	[illegible]	0	0	0
RAD	0000	0.391	55	256	0	0	[illegible]
RAD	0000	0.956	55	257	[illegible]	0	0
RAD	0000	0.461	55	[illegible]	0	0	0
RAD	0000	0.766	[illegible]	57	0	0	0
RAD	0000	0.286	56	[illegible]	0	0	0
RAD	0000	0.207	56	[illegible]	0	0	[illegible]
RAD	0000	0.387	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.213	56	[illegible]	[illegible]	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.490	[illegible]	[illegible]	0	0	0
RAD	0000	0.907	56	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.501	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.203	56	[illegible]	[illegible]	0	0
RAD	0000	0.375	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.208	56	[illegible]	0	0	0
RAD	0000	0.275	56	[illegible]	[illegible]	0	0
RAD	0000	0.507	[illegible]	70	[illegible]	0	0
RAD	0000	0.282	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.510	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.936	[illegible]	73	[illegible]	0	0
RAD	0000	0.511	56	74	[illegible]	0	[illegible]
RAD	0000	0.416	56	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.760	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.404	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.210	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.379	56	[illegible]	0	0	[illegible]
RAD	0000	0.209	56	[illegible]	0	0	0
RAD	0000	0.659	56	[illegible]	[illegible]	0	0
RAD	0000	0.980	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.502	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.703	56	[illegible]	[illegible]	0	0
RAD	0000	0.492	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.218	56	[illegible]	[illegible]	0	0
RAD	0000	1.704	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.086	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.529	56	[illegible]	[illegible]	0	0
RAD	0000	0.672	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.040	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.564	56	[illegible]	0	0	0
RAD	0000	0.270	56	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.493	56	[illegible]	0	0	0
RAD	0000	0.277	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.223	56	250	[illegible]	0	0
RAD	0000	0.518	56	251	[illegible]	0	0
RAD	0000	0.215	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.447	56	253	[illegible]	0	0
RAD	0000	0.954	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.391	56	255	[illegible]	0	0
RAD	0000	0.390	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.773	56	257	[illegible]	0	0
RAD	0000	0.310	56	[illegible]	0	0	0
RAD	0000	0.766	[illegible]	58	0	0	0
RAD	0000	0.481	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.903	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.500	[illegible]	42	0	0	0
RAD	0000	1.153	57	[illegible]	0	0	[illegible]
RAD	0000	2.155	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.192	[illegible]	65	0	0	0
RAD	0000	0.482	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.903	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.500	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	-0.640	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.188	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.662	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.252	[illegible]	72	[illegible]	0	0
RAD	0000	2.251	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.201	[illegible]	74	[illegible]	0	0
RAD	0000	1.219	[illegible]	[illegible]	0	0	0
RAD	0000	1.955	[illegible]	[illegible]	0	0	0
RAD	0000	0.961	[illegible]	[illegible]	0	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.653	57	78	0	0	0
RAD	0000	1.000	57	[illegible]	0	0	0
RAD	0000	0.511	57	80	0	0	0
RAD	0000	2.325	57	81	0	0	[illegible]
RAD	0000	2.428	57	92	0	0	0
RAD	0000	1.203	57	93	[illegible]	0	0
RAD	0000	0.653	57	94	[illegible]	0	0
RAD	0000	0.999	57	95	[illegible]	0	0
RAD	0000	0.511	57	96	[illegible]	0	0
RAD	0000	1.220	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.955	57	[illegible]	[illegible]	0	0
RAD	0000	0.961	[illegible]	99	[illegible]	0	[illegible]
RAD	0000	1.251	57	[illegible]	[illegible]	0	0
RAD	0000	2.251	57	[illegible]	[illegible]	0	0
RAD	0000	1.201	57	[illegible]	[illegible]	0	0
RAD	0000	0.640	57	93	0	0	0
RAD	0000	1.198	57	[illegible]	0	0	[illegible]
RAD	0000	0.662	[illegible]	[illegible]	0	0	0
RAD	0000	0.317	57	250	0	0	0
RAD	0000	1.230	57	251	[illegible]	0	0
RAD	0000	0.317	57	252	0	0	0
RAD	0000	0.956	57	[illegible]	0	0	0
RAD	0000	2.277	57	254	0	0	0
RAD	0000	0.956	57	255	0	0	0
RAD	0000	0.773	57	256	0	0	0
RAD	0000	1.853	57	257	0	0	0
RAD	0000	0.773	57	258	0	0	[illegible]
RAD	0000	0.203	58	60	0	0	[illegible]
RAD	0000	0.375	58	[illegible]	0	0	0
RAD	0000	0.208	58	[illegible]	0	0	0
RAD	0000	0.490	58	63	[illegible]	0	0
RAD	0000	0.907	58	[illegible]	[illegible]	0	0
RAD	0000	0.501	58	[illegible]	0	0	0
RAD	0000	0.207	58	[illegible]	[illegible]	0	0
RAD	0000	0.388	58	67	[illegible]	0	0
RAD	0000	0.213	58	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.268	58	69	0	0	[illegible]
RAD	0000	0.490	58	[illegible]	0	0	0
RAD	0000	0.375	58	71	[illegible]	0	0
RAD	0000	[illegible]	58	72	0	0	0
RAD	0000	1.185	58	[illegible]	[illegible]	0	0
RAD	0000	0.644	58	[illegible]	[illegible]	0	0
RAD	0000	2.035	58	73	0	0	[illegible]
RAD	0000	1.495	58	[illegible]	[illegible]	0	0
RAD	0000	0.753	58	[illegible]	0	0	0
RAD	0000	0.704	58	[illegible]	[illegible]	0	0
RAD	0000	0.492	78	[illegible]	0	0	0
RAD	0000	0.218	58	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.658	58	91	[illegible]	0	[illegible]
RAD	0000	0.979	58	92	[illegible]	0	0
RAD	0000	0.502	58	[illegible]	[illegible]	0	0
RAD	0000	0.210	58	94	0	0	0
RAD	0000	0.379	58	[illegible]	0	0	0
RAD	0000	0.209	58	95	[illegible]	0	0
RAD	0000	0.416	59	[illegible]	0	0	0
RAD	0000	0.760	58	[illegible]	[illegible]	0	0
RAD	0000	0.405	58	[illegible]	[illegible]	0	0
RAD	0000	0.510	58	[illegible]	0	0	[illegible]
RAD	0000	0.936	58	[illegible]	[illegible]	0	0
RAD	0000	0.511	58	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.275	58	93	0	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.266	61	69	0	0	0
RAD	0000	0.391	61	67	0	0	0
RAD	0000	0.716	61	70	0	0	0
RAD	0000	0.391	61	[illegible]	0	0	0
RAD	0000	0.694	61	72	0	0	0
RAD	0000	1.266	61	[illegible]	0	0	0
RAD	0000	0.694	61	74	0	0	0
RAD	0000	0.507	61	75	0	0	0
RAD	0000	0.918	61	76	0	0	0
RAD	0000	0.507	61	[illegible]	0	0	0
RAD	0000	0.285	61	78	0	0	0
RAD	0000	0.517	61	79	0	0	0
RAD	0000	0.285	61	[illegible]	0	0	0
RAD	0000	0.694	61	81	0	0	0
RAD	0000	1.257	61	82	0	0	0
RAD	0000	0.694	61	[illegible]	0	0	0
RAD	0000	0.299	61	84	0	0	0
RAD	0000	0.544	61	85	0	0	0
RAD	0000	0.299	61	86	0	0	0
RAD	0000	0.486	61	[illegible]	0	0	0
RAD	0000	0.870	61	88	0	0	0
RAD	0000	0.486	61	[illegible]	0	0	0
RAD	0000	0.689	61	[illegible]	0	0	0
RAD	0000	1.275	61	91	0	0	0
RAD	0000	0.690	61	[illegible]	0	0	0
RAD	0000	0.476	61	93	0	0	0
RAD	0000	1.617	61	[illegible]	0	0	0
RAD	0000	0.476	61	[illegible]	0	0	0
RAD	0000	0.374	61	250	0	0	0
RAD	0000	0.754	61	251	0	0	0
RAD	0000	0.286	61	252	0	0	0
RAD	0000	0.586	61	253	0	0	0
RAD	0000	1.284	61	254	0	0	0
RAD	0000	0.507	61	255	0	0	0
RAD	0000	0.388	61	256	0	0	0
RAD	0000	0.903	61	257	0	0	0
RAD	0000	0.375	61	258	0	0	0
RAD	0000	0.343	62	63	0	0	0
RAD	0000	0.652	62	64	0	0	0
RAD	0000	0.425	62	[illegible]	0	0	0
RAD	0000	0.144	62	[illegible]	0	0	0
RAD	0000	0.266	62	[illegible]	0	0	0
RAD	0000	0.153	62	69	0	0	0
RAD	0000	0.207	62	[illegible]	0	0	0
RAD	0000	0.398	62	70	0	0	0
RAD	0000	0.234	62	71	0	0	0
RAD	0000	0.365	62	72	0	0	0
RAD	0000	0.695	62	73	0	0	0
RAD	0000	0.406	62	74	0	0	0
RAD	0000	0.273	62	75	0	0	0
RAD	0000	0.505	62	76	0	0	0
RAD	0000	0.287	62		0	0	0
RAD	0000	0.154	62	76	0	0	0
RAD	0000	0.289	62	[illegible]	0	0	0
RAD	0000	0.162	62	90	0	0	0
RAD	0000	0.369	62	91	0	0	0
RAD	0000	0.691	62	92	0	0	0
RAD	0000	0.398	62	83	0	0	0
RAD	0000	0.158	62	84	0	0	0
RAD	0000	0.299	62	95	0	0	0
RAD	0000	0.173	62	96	0	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.507	58	[illegible]	0	0	[illegible]
RAD	0000	0.282	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.215	39	[illegible]	0	0	0
RAD	0000	0.518	58	251	0	0	0
RAD	0000	0.222	[illegible]	252	[illegible]	0	0
RAD	0000	0.391	[illegible]	[illegible]	0	0	0
RAD	0000	0.954	59	254	[illegible]	0	0
RAD	0000	0.461	59	[illegible]	0	0	0
RAD	0000	0.310	35	256	[illegible]	0	0
RAD	0000	0.773	[illegible]	[illegible]	0	0	0
RAD	0000	0.466	39	258	0	0	0
RAD	0000	0.308	[illegible]	61	[illegible]	0	0
RAD	0000	0.146	[illegible]	[illegible]	0	0	0
RAD	0000	0.424	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.652	[illegible]	64	[illegible]	0	0
RAD	0000	0.343	[illegible]	65	[illegible]	0	[illegible]
RAD	0000	0.153	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.256	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.144	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.234	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.398	[illegible]	70	[illegible]	0	[illegible]
RAD	0000	0.207	50	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.406	[illegible]	72	[illegible]	0	0
RAD	0000	0.675	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.365	[illegible]	74	[illegible]	0	[illegible]
RAD	0000	0.287	[illegible]	75	[illegible]	0	[illegible]
RAD	0000	0.505	[illegible]	76	[illegible]	0	0
RAD	0000	0.272	60		0	0	0
RAD	0000	0.162	60	78	[illegible]	0	0
RAD	0000	0.235	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.154	60	[illegible]	0	0	[illegible]
RAD	0000	0.398	[illegible]	[illegible]	0	0	0
RAD	0000	0.691	[illegible]	[illegible]	0	0	0
RAD	0000	0.369	[illegible]	83	0	0	[illegible]
RAD	0000	0.173	[illegible]	84	0	0	0
RAD	0000	0.299	50	[illegible]	0	0	0
RAD	0000	0.158	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.272	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.478	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.262	[illegible]	89	0	0	[illegible]
RAD	0000	0.448	60	[illegible]	0	0	[illegible]
RAD	0000	0.671	60	[illegible]	[illegible]	0	0
RAD	0000	0.348	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.798	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.473	[illegible]	94	[illegible]	0	0
RAD	0000	0.200	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.164	[illegible]	250	[illegible]	0	[illegible]
RAD	0000	0.335	[illegible]	251	[illegible]	0	0
RAD	0000	0.158	[illegible]	252	[illegible]	0	0
RAD	0000	0.292	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.679	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.279	50	[illegible]	0	0	0
RAD	0000	0.213	60	256	0	0	0
RAD	0000	0.500	50	257	0	0	[illegible]
RAD	0000	0.208	60	[illegible]	0	0	0
RAD	0000	0.308	[illegible]	[illegible]	0	0	0
RAD	0000	0.657	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.186	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.657	61	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.266	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.479	[illegible]	[illegible]	[illegible]	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.262	62	[illegible]	[illegible]	0	0
RAD	0000	0.478	62	[illegible]	[illegible]	0	0
RAD	0000	0.272	62	59	0	0	[illegible]
RAD	0000	0.348	62	[illegible]	0	0	0
RAD	0000	0.671	62	[illegible]	0	0	0
RAD	0000	0.448	62	[illegible]	0	0	[illegible]
RAD	0000	0.200	62	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.474	62	[illegible]	[illegible]	0	0
RAD	0000	0.798	62	[illegible]	[illegible]	0	0
RAD	0000	0.622	62	250	[illegible]	0	0
RAD	0000	0.512	62	251	0	0	0
RAD	0000	0.159	62	252	0	0	0
RAD	0000	0.352	62	253	0	0	0
RAD	0000	0.698	62	254	[illegible]	0	[illegible]
RAD	0000	0.274	62	255	0	0	[illegible]
RAD	0000	0.207	62	256	0	0	0
RAD	0000	0.482	62	257	[illegible]	0	0
RAD	0000	0.203	62	258	[illegible]	0	0
RAD	0000	1.534	[illegible]	64	0	0	0
RAD	0000	0.812	[illegible]	65	0	0	[illegible]
RAD	0000	0.425	[illegible]	66	0	0	0
RAD	0000	0.657	63	[illegible]	0	0	0
RAD	0000	0.343	63	[illegible]	[illegible]	0	0
RAD	0000	0.714	[illegible]	[illegible]	0	0	0
RAD	0000	0.999	63	70	[illegible]	0	[illegible]
RAD	0000	0.483	[illegible]	71	[illegible]	0	0
RAD	0000	1.051	63	72	0	0	[illegible]
RAD	0000	1.635	63	[illegible]	[illegible]	0	0
RAD	0000	0.856	63	[illegible]	0	0	0
RAD	0000	0.678	63	75	0	0	0
RAD	0000	1.186	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.640	63	[illegible]	[illegible]	0	0
RAD	0000	0.399	[illegible]	[illegible]	0	0	0
RAD	0000	0.674	63	79	0	0	0
RAD	0000	0.370	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.951	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.649	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.578	63	[illegible]	0	0	0
RAD	0000	0.399	[illegible]	[illegible]	0	0	0
RAD	0000	0.574	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.369	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.678	63	[illegible]	0	0	0
RAD	0000	1.186	[illegible]	[illegible]	0	0	0
RAD	0000	0.640	63	[illegible]	0	0	0
RAD	0000	1.050	63	[illegible]	0	0	0
RAD	0000	1.635	[illegible]	91	[illegible]	0	[illegible]
RAD	0000	0.856	[illegible]	92	0	0	0
RAD	0000	0.714	[illegible]	93	[illegible]	0	0
RAD	0000	0.999	63	[illegible]	0	0	0
RAD	0000	0.483	63	95	0	0	0
RAD	0000	0.378	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.907	63	251	[illegible]	0	[illegible]
RAD	0000	0.378	[illegible]	252	[illegible]	0	0
RAD	0000	0.677	[illegible]	253	0	0	[illegible]
RAD	0000	1.616	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.677	[illegible]	255	0	0	[illegible]
RAD	0000	0.501	[illegible]	256	0	0	[illegible]
RAD	0000	1.172	[illegible]	257	[illegible]	0	0
RAD	0000	0.501	63	258	0	0	[illegible]
RAD	0000	1.534	[illegible]	65	0	0	0
RAD	0000	0.652	[illegible]	[illegible]	[illegible]	0	[illegible]

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OF POOR QUALITY

RAD	0000	1.186	64	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.652	64	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.976	64	69	0	0	0
RAD	0000	1.938	64	70	0	0	0
RAD	0000	0.976	64	71	0	0	0
RAD	0000	1.687	64	[illegible]	[illegible]	0	0
RAD	0000	3.142	64	73	0	0	0
RAD	0000	1.687	64	[illegible]	0	0	0
RAD	0000	1.192	64	75	0	0	0
RAD	0000	2.156	64	[illegible]	[illegible]	0	0
RAD	0000	1.192	64	77	0	0	0
RAD	0000	0.693	64	78	[illegible]	0	0
RAD	0000	1.259	64	79	[illegible]	0	0
RAD	0000	0.693	64	80	[illegible]	0	[illegible]
RAD	0000	1.650	64	81	[illegible]	0	0
RAD	0000	[illegible]	64	82	0	0	0
RAD	0000	1.650	64	83	0	0	0
RAD	0000	0.692	64	84	0	0	0
RAD	0000	1.259	64	85	0	0	0
RAD	0000	0.693	64	86	0	0	0
RAD	0000	1.192	64	87	0	0	0
RAD	0000	2.156	64	88	0	0	0
RAD	0000	1.192	64	89	0	0	
RAD	0000	1.687	64	[illegible]	0	0	0
RAD	0000	3.142	64	91	0	0	0
RAD	0000	1.688	64	92	0	0	0
RAD	0000	0.976	64	93	0	0	0
RAD	0000	1.938	64	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.976	64	95	0	0	0
RAD	0000	0.735	64	250	[illegible]	0	0
RAD	0000	1.825	64	251	[illegible]	0	0
RAD	0000	0.735	64	252	[illegible]	0	0
RAD	0000	1.284	64	253	[illegible]	0	0
RAD	0000	3.100	64	254	0	0	[illegible]
RAD	0000	1.284	64	255	[illegible]	0	0
RAD	0000	0.907	64	255	[illegible]	0	0
RAD	0000	2.155	64	257	0	0	0
RAD	0000	0.907	64	258	0	0	0
RAD	0000	0.343	65	66	[illegible]	0	0
RAD	0000	0.557	55	67	0	0	
RAD	0000	0.425	65	68	0	0	0
RAD	0000	0.483	65	69	0	0	0
RAD	0000	0.999	65	70	[illegible]	0	0
RAD	0000	0.714	65	71	[illegible]	0	0
RAD	0000	0.856	65	72	[illegible]	0	0
RAD	0000	1.585	65	[illegible]	[illegible]	0	0
RAD	0000	1.051	65	[illegible]	[illegible]	0	0
RAD	0000	0.640	55	75	[illegible]	0	0
RAD	0000	1.186	65	76	[illegible]	0	0
RAD	0000	0.678	65	77	0	0	0
RAD	0000	0.370	65	78	0	0	0
RAD	0000	0.694	65	[illegible]	0	0	0
RAD	0000	0.399	65	80	0	0	0
RAD	0000	0.578	65	81	[illegible]	0	0
RAD	0000	1.649	65	82	0	0	0
RAD	0000	0.951	65	83	[illegible]	0	[illegible]
RAD	0000	0.369	65	84	[illegible]	0	0
RAD	0000	0.394	65	[illegible]	[illegible]	0	0
RAD	0000	0.399	65	86	[illegible]	0	0
RAD	0000	0.640	65	[illegible]	0	0	0
RAD	0000	1.186	65	88	0	0	0

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OF POOR QUALITY

RAD	0000	0.678	65	[illegible]	0	0	0
RAD	0000	0.856	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.685	65	[illegible]	0	0	0
RAD	0000	1.031	55	[illegible]	0	0	[illegible]
RAD	0000	0.483	59	[illegible]	[illegible]	0	0
RAD	0000	0.999	55	[illegible]	0	0	0
RAD	0000	0.714	65	[illegible]	0	0	0
RAD	0000	0.513	55	250	0	0	0
RAD	0000	1.960	65	251	0	0	0
RAD	0000	0.513	[illegible]	252	[illegible]	0	[illegible]
RAD	0000	0.717	63	253	0	0	0
RAD	0000	1.727	[illegible]	234	0	0	0
RAD	0000	0.717	65	233	0	0	0
RAD	0000	0.490	65	256	[illegible]	0	0
RAD	0000	1.153	65	257	0	0	[illegible]
RAD	0000	0.470	[illegible]	258	0	0	0
RAD	0000	0.308	66	67	0	0	0
RAD	0000	0.146	[illegible]	[illegible]	0	0	0
RAD	0000	0.798	66	69	0	0	0
RAD	0000	0.474	56	[illegible]	0	0	0
RAD	0000	0.200	66	71	[illegible]	0	0
RAD	0000	0.449	[illegible]	72	0	0	0
RAD	0000	0.671	66	73	0	0	0
RAD	0000	0.348	[illegible]	74	0	0	0
RAD	0000	0.272	66	[illegible]	0	0	0
RAD	0000	0.478	55	[illegible]	[illegible]	0	0
RAD	0000	0.262	66	[illegible]	0	0	0
RAD	0000	0.173	[illegible]	[illegible]	0	0	0
RAD	0000	0.299	66	[illegible]	0	0	0
RAD	0000	0.158	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.398	66	81	[illegible]	0	0
RAD	0000	0.691	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.369	66	[illegible]	[illegible]	0	0
RAD	0000	0.162	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.285	66	[illegible]	[illegible]	0	0
RAD	0000	0.154	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.287	66	[illegible]	[illegible]	0	0
RAD	0000	0.305	66	[illegible]	0	0	0
RAD	0000	0.273	66	[illegible]	0	0	0
RAD	0000	0.406	[illegible]	[illegible]	0	0	0
RAD	0000	0.695	66	[illegible]	0	0	0
RAD	0000	0.265	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.234	66	93	[illegible]	0	0
RAD	0000	0.398	[illegible]	94	[illegible]	0	0
RAD	0000	0.207	66	[illegible]	0	0	0
RAD	0000	0.158	[illegible]	250	0	0	0
RAD	0000	0.386	66	251	0	0	[illegible]
RAD	0000	0.154	66	252	0	0	0
RAD	0000	0.279	[illegible]	253	0	0	0
RAD	0000	0.579	[illegible]	254	0	0	0
RAD	0000	0.292	66	255	0	0	0
RAD	0000	0.208	[illegible]	256	[illegible]	0	[illegible]
RAD	0000	0.500	66	237	[illegible]	0	[illegible]
RAD	0000	0.213	[illegible]	258	0	0	[illegible]
RAD	0000	0.308	67	69	[illegible]	0	0
RAD	0000	0.476	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.617	[illegible]	70	[illegible]	0	0
RAD	0000	0.476	[illegible]	71	[illegible]	0	0
RAD	0000	0.690	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.275	[illegible]	[illegible]	0	0	0
RAD	0000	0.690	[illegible]	[illegible]	0	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.486	67	75	0	0	[illegible]
RAD	0000	0.370	[illegible]	76	[illegible]	0	0
RAD	0000	0.486	67	77	0	0	0
RAD	0000	0.299	[illegible]	78	0	0	0
RAD	0000	0.545	67	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.299	67	[illegible]	0	0	[illegible]
RAD	0000	0.694	67	81	0	0	0
RAD	0000	1.257	[illegible]	[illegible]	0	0	0
RAD	0000	0.694	67	83	0	0	[illegible]
RAD	0000	0.285	[illegible]	[illegible]	0	0	0
RAD	0000	0.517	67	85	0	0	0
RAD	0000	0.285	67	[illegible]	0	0	0
RAD	0000	0.507	67	[illegible]	0	0	[illegible]
RAD	0000	0.918	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.507	67	[illegible]	0	0	0
RAD	0000	0.694	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.266	67	[illegible]	[illegible]	0	0
RAD	0000	0.694	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.391	67	93	[illegible]	0	0
RAD	0000	0.716	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.391	67	[illegible]	0	0	[illegible]
RAD	0000	0.286	67	250	0	0	0
RAD	0000	0.754	67	251	0	0	0
RAD	0000	0.374	[illegible]	252	0	0	[illegible]
RAD	0000	0.507	67	[illegible]	0	0	[illegible]
RAD	0000	1.284	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.586	67	255	0	0	0
RAD	0000	0.375	67	256	0	0	0
RAD	0000	0.903	67	257	0	0	0
RAD	0000	0.388	67	258	0	0	0
RAD	0000	0.200	68	[illegible]	0	0	0
RAD	0000	0.474	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.798	[illegible]	[illegible]	0	0	0
RAD	0000	0.348	[illegible]	72	0	0	[illegible]
RAD	0000	0.671	49	[illegible]	0	0	[illegible]
RAD	0000	0.448	[illegible]	74	0	0	0
RAD	0000	0.262	[illegible]	75	0	0	0
RAD	0000	0.478	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.272	[illegible]	77	0	0	0
RAD	0000	0.158	[illegible]	[illegible]	0	0	0
RAD	0000	0.299	[illegible]	[illegible]	0	0	0
RAD	0000	0.173	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.369	49	91	0	0	0
RAD	0000	0.671	[illegible]	[illegible]	0	0	0
RAD	0000	0.398	49	[illegible]	0	0	[illegible]
RAD	0000	0.154	[illegible]	84	0	0	0
RAD	0000	0.285	68	85	0	0	0
RAD	0000	0.162	[illegible]	[illegible]	0	0	0
RAD	0000	0.273	[illegible]	[illegible]	0	0	0
RAD	0000	0.305	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.287	49	89	0	0	0
RAD	0000	0.365	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.695	49	[illegible]	[illegible]	0	0
RAD	0000	0.406	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.207	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.398	[illegible]	[illegible]	0	0	0
RAD	0000	0.234	68	[illegible]	[illegible]	0	0
RAD	0000	0.159	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.512	68	251	0	0	0
RAD	0000	0.223	[illegible]	252	0	0	0
RAD	0000	0.274	[illegible]	253	[illegible]	0	[illegible]

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OF POOR QUALITY

RAD	0000	0.698	49	254	0	0	0
RAD	0000	0.352	[illegible]	[illegible]	0	0	0
RAD	0000	0.203	49	256	0	0	0
RAD	0000	0.482	49	257	0	0	0
RAD	0000	0.207	[illegible]	238	[illegible]	0	0
RAD	0000	1.345	[illegible]	70	[illegible]	0	0
RAD	0000	0.704	[illegible]	71	[illegible]	0	0
RAD	0000	0.713	69	[illegible]	[illegible]	0	0
[illegible]	0000	1.153	69	73	[illegible]	0	0
[illegible]	0000	0.625	[illegible]	74	0	0	0
.D	0000	0.364	[illegible]	75	0	0	0
RAD	0000	0.648	67	[illegible]	0	0	0
RAD	0000	0.357	49	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.208	69	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.370	69	77	[illegible]	0	0
RAD	0000	0.200	[illegible]	[illegible]	0	0	0
RAD	0000	0.513	69	91	[illegible]	0	0
RAD	0000	0.904	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.487	69	93	0	0	0
RAD	0000	0.218	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.385	69	95	[illegible]	0	0
RAD	0000	0.208	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.390	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.683	[illegible]	88	0	0	0
RAD	0000	0.368	[illegible]	[illegible]	0	0	0
RAD	0000	0.590	67	[illegible]	[illegible]	0	0
RAD	0000	0.992	[illegible]	[illegible]	0	0	0
RAD	0000	0.513	[illegible]	[illegible]	0	0	0
RAD	0000	0.381	[illegible]	[illegible]	0	0	0
RAD	0000	0.619	[illegible]	[illegible]	0	0	0
RAD	0000	0.308	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.235	67	[illegible]	[illegible]	0	0
RAD	0000	0.559	69	251	0	0	0
RAD	0000	0.372	[illegible]	252	0	0	0
RAD	0000	0.394	[illegible]	253	0	0	0
RAD	0000	0.930	[illegible]	[illegible]	[illegible]	[illegible]	0
RAD	0000	0.425	69	235	0	0	[illegible]
RAD	0000	[illegible]	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.662	69	[illegible]	0	0	0
RAD	0000	0.275	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.345	[illegible]	71	0	0	0
RAD	0000	1.163	[illegible]	[illegible]	0	0	0
RAD	0000	2.073	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.163	[illegible]	74	0	0	0
RAD	0000	0.648	[illegible]	75	0	0	0
RAD	0000	1.167	[illegible]	76	0	0	0
RAD	0000	0.648	70	[illegible]	0	0	0
RAD	0000	0.365	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.664	70	79	[illegible]	0	[illegible]
RAD	0000	0.365	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.901	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.635	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.901	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.384	70	84	0	0	0
RAD	0000	0.697	[illegible]	85	[illegible]	0	0
RAD	0000	0.384	[illegible]	86	[illegible]	0	0
RAD	0000	0.683	70	[illegible]	[illegible]	0	0
RAD	0000	1.236	[illegible]	88	0	0	0
RAD	0000	0.683	[illegible]	89	[illegible]	0	0
RAD	0000	0.995	70	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.818	[illegible]	[illegible]	0	0	0

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OF POOR QUALITY

RAD	0000	0.995	70	92	0	0	0
RAD	0000	0.618	70	93	0	0	0
RAD	0000	1.145	70	94	0	0	0
RAD	0000	0.619	70	95	0	0	0
RAD	0000	0.443	70	250	0	0	0
RAD	0000	1.152	70	251	0	0	0
RAD	0000	0.769	70	252	0	0	0
RAD	0000	0.723	70	253	0	0	0
RAD	0000	1.760	70	254	0	0	0
RAD	0000	0.802	70	255	0	0	0
RAD	0000	0.507	70	256	0	0	0
RAD	0000	1.138	70	257	0	0	0
RAD	0000	0.490	70	258	0	0	0
RAD	0000	0.625	71	72	0	0	0
RAD	0000	1.153	71	73	0	0	0
RAD	0000	0.713	71	74	0	0	0
RAD	0000	0.357	71	75	0	0	0
RAD	0000	0.648	71	76	0	0	0
RAD	0000	0.364	71	77	0	0	0
RAD	0000	0.200	71	78	0	0	0
RAD	0000	0.370	71	79	0	0	0
RAD	0000	0.208	71	80	0	0	0
RAD	0000	0.487	71	81	0	0	0
RAD	0000	0.904	71	82	0	0	0
RAD	0000	0.513	71	83	0	0	0
RAD	0000	0.208	71	84	0	0	0
RAD	0000	0.385	71	85	0	0	0
RAD	0000	0.218	71	86	0	0	0
RAD	0000	0.368	71	87	0	0	0
RAD	0000	0.653	71	88	0	0	0
RAD	0000	0.390	71	89	0	0	0
RAD	0000	0.513	71	90	0	0	0
RAD	0000	0.992	71	91	0	0	0
RAD	0000	0.590	71	92	0	0	0
RAD	0000	0.308	71	93	0	0	0
RAD	0000	0.619	71	94	0	0	0
RAD	0000	0.391	71	95	0	0	0
RAD	0000	0.243	71	250	0	0	0
RAD	0000	0.740	71	251	0	0	0
RAD	0000	1.300	71	252	0	0	0
RAD	0000	0.389	71	253	0	0	0
RAD	0000	0.768	71	254	0	0	0
RAD	0000	0.533	71	255	0	0	0
RAD	0000	0.275	71	256	0	0	0
RAD	0000	0.640	71	257	0	0	0
RAD	0000	0.268	71	258	0	0	0
RAD	0000	2.346	72	73	0	0	0
RAD	0000	1.273	72	74	0	0	0
RAD	0000	1.221	72	75	0	0	0
RAD	0000	2.059	72	76	0	0	0
RAD	0000	1.119	72	77	0	0	0
RAD	0000	0.410	72	78	0	0	0
RAD	0000	0.671	72	79	0	0	0
RAD	0000	0.348	72	80	0	0	0
RAD	0000	0.999	72	81	0	0	0
RAD	0000	1.654	72	82	0	0	0
RAD	0000	0.855	72	83	0	0	0
RAD	0000	0.401	72	84	0	0	0
RAD	0000	0.690	72	85	0	0	0
RAD	0000	0.365	72	86	0	0	0
RAD	0000	0.755	72	87	0	0	0

OF POOR QUALITY

RAD	0000	1.281	72	88	0	0	0
RAD	0000	0.667	72	89	0	0	0
RAD	0000	1.048	72	90	0	0	0
RAD	0000	1.745	72	91	0	0	0
RAD	0000	0.894	72	92	0	0	0
RAD	0000	0.590	72	[illegible]	0	0	0
RAD	0000	0.995	72	74	0	0	0
RAD	0000	0.513	72	75	0	0	0
RAD	0000	0.393	72	250	0	0	0
RAD	0000	0.925	72	251	0	0	0
RAD	0000	0.425	72	252	0	0	0
RAD	0000	0.686	72	253	0	0	0
RAD	0000	1.619	72	254	0	0	0
RAD	0000	0.797	72	255	0	0	0
RAD	0000	0.511	72	256	0	0	0
RAD	0000	1.201	72	257	0	0	0
RAD	0000	0.544	72	258	0	0	0
RAD	0000	2.346	73	74	0	0	0
RAD	0000	2.049	73	75	0	0	0
RAD	0000	3.679	73	76	0	0	0
RAD	0000	2.049	73	77	0	0	0
RAD	0000	0.655	73	73	0	0	0
RAD	0000	1.212	73	79	0	0	0
RAD	0000	0.655	73	90	0	0	0
RAD	0000	1.642	73	91	0	0	0
RAD	0000	3.043	73	92	0	0	0
RAD	0000	1.652	73	83	0	0	0
RAD	0000	0.671	73	[illegible]	0	0	0
RAD	0000	1.257	73	95	0	0	0
RAD	0000	0.591	73	[illegible]	0	0	0
RAD	0000	1.278	73	[illegible]	0	0	0
RAD	0000	2.136	73	98	0	0	0
RAD	0000	1.278	73	90	0	0	0
RAD	0000	1.745	73	[illegible]	0	0	0
RAD	0000	3.202	73	91	0	0	0
RAD	0000	1.745	73	92	0	0	0
RAD	0000	0.991	73	[illegible]	0	0	0
RAD	0000	1.818	73	94	0	0	0
RAD	0000	0.992	73	95	0	0	0
RAD	0000	0.724	[illegible]	250	0	0	0
RAD	0000	1.757	73	251	0	0	0
RAD	0000	0.795	73	252	0	0	0
RAD	0000	1.266	73	253	0	0	0
RAD	0000	3.156	73	254	0	0	0
RAD	0000	1.552	73	255	0	0	0
RAD	0000	0.936	73	256	0	0	0
RAD	0000	2.251	73	257	0	0	0
RAD	0000	1.185	73	[illegible]	0	0	0
RAD	0000	1.119	[illegible]	73	0	0	0
RAD	0000	2.059	[illegible]	76	0	0	0
RAD	0000	1.221	[illegible]	[illegible]	0	0	0
RAD	0000	0.348	[illegible]	78	0	0	0
RAD	0000	0.671	[illegible]	[illegible]	0	0	0
RAD	0000	0.410	[illegible]	[illegible]	0	0	0
RAD	0000	0.855	[illegible]	81	0	0	0
RAD	0000	1.654	[illegible]	[illegible]	0	0	0
RAD	0000	0.999	[illegible]	[illegible]	0	0	0
RAD	0000	0.353	[illegible]	94	0	0	0
RAD	0000	0.690	[illegible]	95	0	0	0
RAD	0000	0.401	[illegible]	96	0	0	0
RAD	0000	0.667	[illegible]	[illegible]	0	0	0

RAD	0000	1.281	[illegible]	[illegible]	0	0	0
RAD	0000	0.755	[illegible]	89	[illegible]	0	[illegible]
RAD	0000	0.894	74	[illegible]	0	0	0
RAD	0000	1.745	74	[illegible]	[illegible]	0	0
RAD	0000	1.048	[illegible]	[illegible]	0	0	0
RAD	0000	0.51[illegible]	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.995	[illegible]	[illegible]	0	0	0
RAD	0000	0.590	[illegible]	[illegible]	0	0	0
RAD	0000	0.397	[illegible]	250	0	0	0
RAD	0000	0.993	[illegible]	251	[illegible]	0	0
RAD	0000	0.544	[illegible]	252	0	0	0
RAD	0000	0.684	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.849	74	254	0	0	0
RAD	0000	2.129	[illegible]	255	0	0	0
RAD	0000	0.511	74	256	0	0	0
RAD	0000	1.252	[illegible]	257	[illegible]	0	0
RAD	0000	0.755	[illegible]	256	0	0	0
RAD	0000	3.060	75	76	0	0	0
RAD	0000	1.628	[illegible]	[illegible]	0	0	0
RAD	0000	0.899	73	[illegible]	0	0	0
RAD	0000	0.608	[illegible]	[illegible]	0	0	0
RAD	0000	0.264	[illegible]	80	[illegible]	0	[illegible]
RAD	0000	0.933	75	[illegible]	0	0	0
RAD	0000	1.299	[illegible]	[illegible]	0	0	0
RAD	0000	0.639	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.310	75	84	[illegible]	0	0
RAD	0000	0.518	73	[illegible]	[illegible]	0	0
RAD	0000	0.274	75	[illegible]	0	0	[illegible]
RAD	0000	0.649	73	[illegible]	[illegible]	0	0
RAD	0000	1.058	75	[illegible]	0	0	0
RAD	0000	0.530	[illegible]	[illegible]	0	0	0
RAD	0000	[illegible]	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.278	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	0.667	[illegible]	[illegible]	0	0	0
RAD	0000	0.390	[illegible]	93	0	0	0
RAD	0000	0.683	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.368	75	[illegible]	0	0	0
RAD	0000	0.282	75	[illegible]	0	0	[illegible]
RAD	0000	0.661	[illegible]	251	0	0	0
RAD	0000	0.274	[illegible]	[illegible]	0	0	0
RAD	0000	0.512	73	[illegible]	0	0	0
RAD	0000	1.206	[illegible]	[illegible]	0	0	0
RAD	0000	0.629	73	[illegible]	0	0	0
RAD	0000	0.404	[illegible]	[illegible]	0	0	0
RAD	0000	0.961	[illegible]	257	0	0	0
RAD	0000	0.753	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	3.060	[illegible]	77	0	0	0
RAD	0000	0.605	[illegible]	78	0	0	0
RAD	0000	1.884	[illegible]	[illegible]	0	0	0
RAD	0000	0.605	[illegible]	[illegible]	[illegible]	0	[illegible]
RAD	0000	1.322	[illegible]	91	[illegible]	0	0
RAD	0000	2.562	[illegible]	[illegible]	0	0	0
RAD	0000	1.322	[illegible]	[illegible]	0	0	0
RAD	0000	0.527	[illegible]	[illegible]	0	0	0
RAD	0000	0.950	[illegible]	[illegible]	0	0	0
RAD	0000	0.528	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	1.058	[illegible]	[illegible]	0	0	0
RAD	0000	1.956	[illegible]	[illegible]	[illegible]	0	0
RAD	0000	1.058	[illegible]	[illegible]	0	0	0
RAD	0000	1.281	[illegible]	[illegible]	0	0	0
RAD	0000	2.336	[illegible]	91	0	0	0

RAD	0000	1.281	76	92	0	0	0
RAD	0000	0.683	76	93	0	0	0
RAD	0000	1.236	76	94	0	0	0
RAD	0000	0.683	76	95	0	0	0
RAD	0000	0.507	76	250	0	0	0
RAD	0000	1.187	76	251	0	0	0
RAD	0000	0.489	76	252	0	0	0
RAD	0000	0.935	76	253	0	0	0
RAD	0000	2.253	76	254	0	0	0
RAD	0000	1.162	76	255	0	0	0
RAD	0000	0.760	76	256	0	0	0
RAD	0000	1.955	76	257	0	0	0
RAD	0000	1.495	76	258	0	0	0
RAD	0000	0.264	77	78	0	0	0
RAD	0000	0.608	77	79	0	0	0
RAD	0000	0.899	77	80	0	0	0
RAD	0000	0.639	77	81	0	0	0
RAD	0000	1.299	77	82	0	0	0
RAD	0000	0.933	77	83	0	0	0
RAD	0000	0.274	77	84	0	0	0
RAD	0000	0.518	77	85	0	0	0
RAD	0000	0.310	77	86	0	0	0
RAD	0000	0.530	77	87	0	0	0
RAD	0000	1.058	77	88	0	0	0
RAD	0000	0.649	77	89	0	0	0
RAD	0000	0.667	77	90	0	0	0
RAD	0000	1.278	77	91	0	0	0
RAD	0000	0.755	[illegible]	92	0	0	0
RAD	0000	0.368	77	93	0	0	0
RAD	0000	0.683	77	94	0	0	0
RAD	0000	0.390	77	95	0	0	0
RAD	0000	0.276	77	250	0	0	0
RAD	0000	0.643	77	251	0	0	0
RAD	0000	0.258	77	252	0	0	0
RAD	0000	0.503	77	253	0	0	0
RAD	0000	1.230	77	254	0	0	0
RAD	0000	0.728	77	255	0	0	0
RAD	0000	0.416	77	256	0	0	0
RAD	0000	1.219	77	257	0	0	0
RAD	0000	2.035	[illegible]	258	0	0	0
RAD	0000	1.098	78	79	0	0	0
RAD	0000	0.582	78	80	0	0	0
RAD	0000	1.293	78	81	0	0	0
RAD	0000	2.141	78	82	0	0	0
RAD	0000	1.158	78	83	0	0	0
RAD	0000	0.589	78	84	0	0	0
RAD	0000	1.008	78	85	0	0	0
RAD	0000	0.555	78	86	0	0	0
RAD	0000	0.310	78	87	0	0	0
RAD	0000	0.528	78	88	0	0	0
RAD	0000	0.274	78	89	0	0	0
RAD	0000	0.401	78	90	0	0	0
RAD	0000	0.691	78	91	0	0	0
RAD	0000	0.365	78	92	0	0	0
RAD	0000	0.218	78	93	0	0	0
RAD	0000	0.384	78	94	0	0	0
RAD	0000	0.208	78	95	0	0	0
RAD	0000	0.159	78	250	0	0	0
RAD	0000	0.381	78	251	0	0	0
RAD	0000	0.162	78	252	0	0	0
RAD	0000	0.279	78	253	0	0	0

ORIGINAL PAGE IS OF POOR QUALITY

RAD	0000	0.678	[illegible]	254	0	0	0
RAD	0000	0.291	78	255	0	0	0
RAD	0000	0.209	78	256	0	0	0
RAD	0000	0.511	[illegible]	257	0	0	0
RAD	0000	0.218	[illegible]	258	0	0	0
RAD	0000	1.098	[illegible]	[illegible]	0	0	0
RAD	0000	2.133	79	81	0	0	0
RAD	0000	3.839	[illegible]	82	0	0	0
RAD	0000	2.133	79	83	0	0	0
RAD	0000	1.004	79	84	0	0	0
RAD	0000	1.793	[illegible]	85	0	0	0
RAD	0000	1.004	79	[illegible]	0	0	0
RAD	0000	0.518	[illegible]	[illegible]	0	0	0
RAD	0000	0.950	79	[illegible]	0	0	0
RAD	0000	0.518	79	[illegible]	0	0	0
RAD	0000	0.691	[illegible]	[illegible]	0	0	0
RAD	0000	1.257	79	[illegible]	0	0	0
RAD	0000	0.690	79	[illegible]	0	0	0
RAD	0000	0.385	[illegible]	[illegible]	0	0	0
RAD	0000	0.698	[illegible]	[illegible]	0	0	0
RAD	0000	0.385	[illegible]	[illegible]	0	0	0
RAD	0000	0.286	[illegible]	[illegible]	0	0	0
RAD	0000	0.687	[illegible]	251	0	0	0
RAD	0000	0.294	[illegible]	252	0	0	0
RAD	0000	0.505	79	233	0	0	0
RAD	0000	1.261	[illegible]	254	0	0	0
RAD	0000	0.563	[illegible]	235	0	0	0
RAD	0000	0.379	79	256	0	0	0
RAD	0000	1.000	79	257	0	0	0
RAD	0000	0.492	[illegible]	[illegible]	0	0	0
RAD	0000	1.158	[illegible]	81	0	0	0
RAD	0000	2.141	[illegible]	[illegible]	0	0	0
RAD	0000	1.293	[illegible]	93	0	0	0
RAD	0000	0.555	80	[illegible]	0	0	0
RAD	0000	1.008	80	95	0	0	0
RAD	0000	0.589	[illegible]	96	0	0	0
RAD	0000	0.274	[illegible]	[illegible]	0	0	0
RAD	0000	0.528	[illegible]	[illegible]	0	0	0
RAD	0000	0.310	[illegible]	99	0	0	0
RAD	0000	0.365	[illegible]	[illegible]	0	0	0
RAD	0000	0.691	[illegible]	[illegible]	0	0	0
RAD	0000	0.401	80	[illegible]	0	0	0
RAD	0000	0.208	[illegible]	93	0	0	0
RAD	0000	0.384	[illegible]	[illegible]	0	0	0
RAD	0000	0.218	[illegible]	[illegible]	0	0	0
RAD	0000	0.135	[illegible]	[illegible]	0	0	0
RAD	0000	0.368	[illegible]	251	0	0	0
RAD	0000	0.158	80	[illegible]	0	0	0
RAD	0000	0.272	[illegible]	[illegible]	0	0	0
RAD	0000	0.674	[illegible]	[illegible]	0	0	0
RAD	0000	0.318	80	255	0	0	0
RAD	0000	0.210	[illegible]	256	0	0	0
RAD	0000	0.653	[illegible]	257	0	0	0
RAD	0000	0.704	80	236	0	0	0
RAD	0000	4.356	[illegible]	92	0	0	0
RAD	0000	2.359	[illegible]	83	0	0	0
RAD	0000	1.281	[illegible]	[illegible]	0	0	0
RAD	0000	2.111	[illegible]	[illegible]	0	0	0
RAD	0000	1.147	[illegible]	[illegible]	0	0	0
RAD	0000	0.934	81	[illegible]	0	0	0
RAD	0000	1.322	[illegible]	[illegible]	0	0	0

ORIGINAL PAGE IS
OF POOR QUALITY

RAD	0000	0.639	81	89	0	0	0
RAD	0000	0.999	81	90	0	0	0
RAD	0000	1.652	81	91	0	0	0
RAD	0000	0.855	81	92	0	0	0
RAD	0000	0.513	81	93	0	0	0
RAD	0000	0.901	81	94	0	0	0
RAD	0000	0.487	81	95	0	0	0
RAD	0000	0.381	81	250	0	0	0
RAD	0000	0.906	81	251	0	0	0
RAD	0000	0.361	81	252	0	0	0
RAD	0000	0.676	81	253	0	0	0
RAD	0000	1.611	81	254	0	0	0
RAD	0000	0.676	81	255	0	0	0
RAD	0000	0.502	81	256	0	0	0
RAD	0000	1.203	81	257	0	0	0
RAD	0000	0.502	81	258	0	0	0
RAD	0000	4.356	82	83	0	0	0
RAD	0000	2.112	82	84	0	0	0
RAD	0000	3.777	82	85	0	0	0
RAD	0000	2.112	82	86	0	0	0
RAD	0000	1.300	82	87	0	0	0
RAD	0000	2.562	82	88	0	0	0
RAD	0000	1.300	82	89	0	0	0
RAD	0000	1.655	82	90	0	0	0
RAD	0000	3.043	82	91	0	0	0
RAD	0000	1.654	82	92	0	0	0
RAD	0000	0.905	82	93	0	0	0
RAD	0000	1.635	82	94	0	0	0
RAD	0000	0.904	82	95	0	0	0
RAD	0000	0.688	82	250	0	0	0
RAD	0000	1.634	82	251	0	0	0
RAD	0000	0.688	82	252	0	0	0
RAD	0000	1.260	82	253	0	0	0
RAD	0000	3.021	82	254	0	0	0
RAD	0000	1.260	82	255	0	0	0
RAD	0000	0.979	82	255	0	0	0
RAD	0000	2.428	82	257	0	0	0
RAD	0000	0.979	82	258	0	0	0
RAD	0000	1.147	82	84	0	0	0
RAD	0000	2.111	83	85	0	0	0
RAD	0000	1.281	83	86	0	0	0
RAD	0000	0.639	83	87	0	0	0
RAD	0000	1.322	83	88	0	0	0
RAD	0000	0.934	83	89	0	0	0
RAD	0000	0.855	83	90	0	0	0
RAD	0000	1.652	83	91	0	0	0
RAD	0000	0.999	83	92	0	0	0
RAD	0000	0.487	83	93	0	0	0
RAD	0000	0.901	83	94	0	0	0
RAD	0000	0.513	83	95	0	0	0
RAD	0000	0.373	83	250	0	0	0
RAD	0000	0.879	83	251	0	0	0
RAD	0000	-0.373	83	252	0	0	0
RAD	0000	0.689	83	253	0	0	0
RAD	0000	1.632	83	254	0	0	0
RAD	0000	0.689	83	255	0	0	0
RAD	0000	0.658	83	256	0	0	0
RAD	0000	2.325	83	257	0	0	0
RAD	0000	0.658	83	258	0	0	0
RAD	0000	1.111	83	95	0	0	0
RAD	0000	0.591	84	96	0	0	0

RAD	0000	0.879	84	[illegible]	0	0	[illegible]
RAD	0000	0.605	[illegible]	[illegible]	0	0	0
RAD	0000	0.264	84	89	0	0	0
RAD	0000	0.410	84	90	[illegible]	0	0
RAD	0000	0.654	84	91	[illegible]	0	0
RAD	0000	0.348	84	[illegible]	[illegible]	0	0
RAD	0000	0.208	84	[illegible]	0	0	0
RAD	0000	0.365	84	94	0	0	0
RAD	0000	0.200	84	95	0	0	0
RAD	0000	0.162	[illegible]	250	0	0	0
RAD	0000	0.381	84	251	0	0	0
RAD	0000	0.159	[illegible]	252	0	0	0
RAD	0000	0.291	84	253	0	0	0
RAD	0000	0.677	84	254	0	0	[illegible]
RAD	0000	0.279	84	255	0	0	0
RAD	0000	0.218	[illegible]	256	[illegible]	0	[illegible]
RAD	0000	0.511	84	257	0	0	[illegible]
RAD	0000	0.209	84	258	[illegible]	0	0
RAD	0000	1.111	85	86	0	0	0
RAD	0000	0.608	85	[illegible]	[illegible]	0	0
RAD	0000	1.883	85	[illegible]	[illegible]	0	0
RAD	0000	0.608	85	89	[illegible]	0	0
RAD	0000	0.671	85	90	[illegible]	0	0
RAD	0000	1.212	85	91	[illegible]	0	0
RAD	0000	0.670	85	92	[illegible]	0	[illegible]
RAD	0000	0.370	85	[illegible]	0	0	[illegible]
RAD	0000	0.664	85	94	0	0	0
RAD	0000	0.370	85	[illegible]	0	0	0
RAD	0000	0.294	85	250	0	0	0
RAD	0000	0.687	85	251	0	0	0
RAD	0000	0.285	85	252	0	0	0
RAD	0000	0.563	[illegible]	253	0	0	[illegible]
RAD	0000	1.260	85	254	0	0	[illegible]
RAD	0000	0.505	85	255	0	0	0
RAD	0000	0.492	85	256	0	0	0
RAD	0000	0.999	85	257	[illegible]	0	[illegible]
RAD	0000	0.379	85	258	0	0	0
RAD	0000	0.254	[illegible]	[illegible]	0	0	0
RAD	0000	0.605	86	88	0	0	0
RAD	0000	0.399	[illegible]	89	0	0	0
RAD	0000	0.348	86	90	[illegible]	0	0
RAD	0000	0.655	86	91	0	0	0
RAD	0000	0.410	86	[illegible]	[illegible]	0	0
RAD	0000	0.200	86	93	[illegible]	0	0
RAD	0000	0.365	86	[illegible]	[illegible]	0	[illegible]
RAD	0000	0.208	86	[illegible]	0	0	[illegible]
RAD	0000	0.158	86	250	[illegible]	0	0
RAD	0000	0.368	86	251	[illegible]	0	0
RAD	0000	0.155	86	252	0	0	[illegible]
RAD	0000	0.318	86	253	0	0	0
RAD	0000	0.674	86	254	0	0	0
RAD	0000	0.272	86	255	[illegible]	0	0
RAD	0000	0.703	86	256	0	0	0
RAD	0000	0.653	86	257	0	0	0
RAD	0000	0.210	86	258	0	0	0
RAD	0000	1.782	[illegible]	88	[illegible]	0	0
RAD	0000	0.935	[illegible]	89	[illegible]	0	0
RAD	0000	0.920	[illegible]	90	[illegible]	0	0
RAD	0000	1.530	[illegible]	91	[illegible]	0	0
RAD	0000	0.233	87	92	[illegible]	0	0
RAD	0000	0.369	87	93	0	0	0

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RAD	0000	0.656	[illegible]	[illegible]	0	0	[illegible]
RAD	0000	0.362	[illegible]	[illegible]	0	0	0
RAD	0000	0.276	67	250	0	0	0
RAD	0000	0.661	[illegible]	251	0	0	0
RAD	0000	0.282	97	252	0	0	0
RAD	0000	0.373	[illegible]	233	0	0	0
RAD	0000	1.206	[illegible]	234	0	0	0
RAD	0000	0.512	97	235	0	0	0
RAD	0000	0.529	[illegible]	[illegible]	0	0	0
RAD	0000	0.961	87	[illegible]	0	0	0
RAD	0000	0.404	67	259	0	0	0
RAD	0000	1.787	99	[illegible]	0	0	0
RAD	0000	1.535	58	90	0	0	0
RAD	0000	2.737	99	[illegible]	0	0	0
RAD	0000	1.536	48	92	0	0	0
RAD	0000	0.655	[illegible]	[illegible]	0	0	0
RAD	0000	1.179	38	[illegible]	0	0	0
RAD	0000	0.655	[illegible]	[illegible]	0	0	0
RAD	0000	0.491	88	[illegible]	0	0	0
RAD	0000	1.187	[illegible]	[illegible]	0	0	0
RAD	0000	0.508	88	252	0	0	0
RAD	0000	1.062	[illegible]	253	0	0	0
RAD	0000	2.253	[illegible]	254	0	0	0
RAD	0000	0.935	88	235	0	0	0
RAD	0000	1.097	88	[illegible]	0	0	0
RAD	0000	1.955	[illegible]	257	0	0	0
RAD	0000	0.760	[illegible]	[illegible]	0	0	0
RAD	0000	0.530	[illegible]	[illegible]	0	0	0
RAD	0000	1.523	67	[illegible]	0	0	0
RAD	0000	0.916	67	[illegible]	0	0	0
RAD	0000	0.361	67	[illegible]	0	0	0
RAD	0000	0.655	67	[illegible]	0	0	0
RAD	0000	0.368	[illegible]	[illegible]	0	0	0
RAD	0000	0.270	[illegible]	250	0	0	0
RAD	0000	0.643	[illegible]	251	0	0	0
RAD	0000	0.276	[illegible]	252	0	0	0
RAD	0000	0.671	[illegible]	253	0	0	0
RAD	0000	1.230	[illegible]	[illegible]	0	0	0
RAD	0000	0.503	67	235	0	0	0
RAD	0000	1.700	[illegible]	[illegible]	0	0	0
RAD	0000	1.220	[illegible]	257	0	0	0
RAD	0000	0.416	[illegible]	258	0	0	0
RAD	0000	2.400	[illegible]	91	0	0	0
RAD	0000	1.302	[illegible]	[illegible]	0	0	0
RAD	0000	0.979	90	93	0	0	0
RAD	0000	1.593	[illegible]	[illegible]	0	0	0
RAD	0000	0.561	90	95	0	0	0
RAD	0000	0.516	[illegible]	250	0	0	0
RAD	0000	0.925	90	251	0	0	0
RAD	0000	0.393	[illegible]	252	0	0	0
RAD	0000	0.817	90	[illegible]	0	0	0
RAD	0000	1.619	90	[illegible]	0	0	0
RAD	0000	0.686	[illegible]	255	0	0	0
RAD	0000	0.563	90	[illegible]	0	0	0
RAD	0000	1.201	[illegible]	257	0	0	0
RAD	0000	0.511	[illegible]	[illegible]	0	0	0
RAD	0000	2.401	91	92	0	0	0
RAD	0000	1.581	[illegible]	[illegible]	0	0	0
RAD	0000	2.832	[illegible]	94	0	0	0
RAD	0000	1.581	[illegible]	[illegible]	0	0	0
RAD	0000	0.957	[illegible]	250	0	0	0

RAD	0000	1.757	91	251	0	0	0
RAD	0000	0.724	91	252	0	0	0
RAD	0000	1.590	91	253	0	0	0
RAD	0000	3.156	91	254	0	0	0
RAD	0000	1.266	91	255	0	0	0
RAD	0000	1.040	91	256	0	0	0
RAD	0000	2.251	91	257	0	0	0
RAD	0000	0.936	91	258	0	0	0
RAD	0000	0.861	92	93	0	0	0
RAD	0000	1.594	92	94	0	0	0
RAD	0000	0.979	92	95	0	0	0
RAD	0000	0.637	92	250	0	0	0
RAD	0000	0.993	92	251	0	0	0
RAD	0000	0.397	92	252	0	0	0
RAD	0000	2.158	92	253	0	0	0
RAD	0000	1.849	92	254	0	0	0
RAD	0000	0.684	92	255	0	0	0
RAD	0000	0.671	92	256	0	0	0
RAD	0000	1.252	92	257	0	0	0
RAD	0000	0.511	92	258	0	0	0
RAD	0000	1.640	93	94	0	0	0
RAD	0000	0.562	93	95	0	0	0
RAD	0000	0.442	93	250	0	0	0
RAD	0000	0.558	93	251	0	0	0
RAD	0000	0.235	93	252	0	0	0
RAD	0000	0.501	93	253	0	0	0
RAD	0000	0.930	93	254	0	0	0
RAD	0000	0.394	93	255	0	0	0
RAD	0000	0.277	93	256	0	0	0
RAD	0000	0.562	93	257	0	0	0
RAD	0000	0.282	93	258	0	0	0
RAD	0000	1.640	94	95	0	0	0
RAD	0000	0.894	94	250	0	0	0
RAD	0000	1.152	94	251	0	0	0
RAD	0000	0.443	94	252	0	0	0
RAD	0000	0.739	94	253	0	0	0
RAD	0000	1.760	94	254	0	0	0
RAD	0000	0.723	94	255	0	0	0
RAD	0000	0.493	94	256	0	0	0
RAD	0000	1.288	94	257	0	0	0
RAD	0000	0.507	94	258	0	0	0
RAD	0000	1.398	95	250	0	0	0
RAD	0000	0.740	95	251	0	0	0
RAD	0000	0.243	95	252	0	0	0
RAD	0000	0.622	95	253	0	0	0
RAD	0000	0.958	95	254	0	0	0
RAD	0000	0.389	95	255	0	0	0
RAD	0000	0.270	95	256	0	0	0
RAD	0000	0.640	95	257	0	0	0
RAD	0000	0.275	95	258	0	0	0
RAD	0000	0.460	250	251	0	0	0
RAD	0000	0.167	250	252	0	0	0
RAD	0000	0.366	250	253	0	0	0
RAD	0000	0.677	250	254	0	0	0
RAD	0000	0.277	250	255	0	0	0
RAD	0000	0.204	250	256	0	0	0
RAD	0000	0.477	250	257	0	0	0
RAD	0000	0.201	250	258	0	0	0
RAD	0000	0.460	251	252	0	0	0
RAD	0000	0.583	251	253	0	0	0
RAD	0000	1.595	251	254	0	0	0

RAD	0000	0.683	251	255	0	0	0
RAD	0000	0.478	251	256	0	0	0
RAD	0000	1.134	251	257	0	0	0
RAD	0000	0.478	251	258	0	0	0
RAD	0000	0.277	252	233	0	0	0
RAD	0000	0.677	252	254	0	0	0
RAD	0000	0.336	252	255	0	0	0
RAD	0000	0.201	252	256	0	0	0
RAD	0000	0.477	252	257	0	0	0
RAD	0000	0.203	252	258	0	0	0
RAD	0000	1.184	253	254	0	0	0
RAD	0000	0.480	253	255	0	0	0
RAD	0000	0.427	253	256	0	0	0
RAD	0000	0.874	253	257	0	0	0
RAD	0000	0.360	253	258	0	0	0
RAD	0000	1.184	254	255	0	0	0
RAD	0000	0.870	254	256	0	0	0
RAD	0000	2.043	254	257	0	0	0
RAD	0000	0.870	254	258	0	0	0
RAD	0000	0.360	255	256	0	0	0
RAD	0000	0.874	255	257	0	0	0
RAD	0000	0.441	255	258	0	0	0
RAD	0000	0.766	256	257	0	0	0
RAD	0000	0.286	256	258	0	0	0
RAD	0000	0.766	257	258	0	0	0

DUMMY THEMATIC MAPPER POWER / BETA=22.8

ORIGINAL PAGE IS OF POOR QUALITY

POWR	0000	22	98.810	49.530
			0.000	65.470
			8.230	61.800
			16.470	50.800
			24.700	39.110
			32.420	104.140
			32.940	34.290
			41.170	34.270
			49.410	34.300
			57.640	34.270
			65.870	34.290
			66.390	76.1[illegible]
			74.110	39.460
			82.3[illegible]	51.3[illegible]
			90.590	62.870
			98.810	65.470
POWR	0000	101	98.810	71.770
			0.000	119.790
			8.230	112.450
			16.470	92.300
			24.700	67.700
			32.420	188.240
			32.940	64.450
			41.170	64.4[illegible]
			49.410	64.470
			57.640	64.460
			65.870	64.450
			66.390	172.530
			74.110	72.670
			82.340	92.740
			90.590	112.820
			98.810	119.790
POWR	0000	103	98.810	28.640
			0.000	35.340
			8.230	41.6[illegible]
			16.470	28.370
			24.700	30.910
			32.420	71.940
			32.940	16.5[illegible]
			41.170	16.610
			49.410	16.480
			57.640	16.600
			65.870	16.550
			66.390	38.260
			74.110	22.8[illegible]
			82.340	26.910
			90.590	37.330
			98.810	35.340
POWR	0000	104	98.810	49.5[illegible]
			0.000	32.400
			8.230	29.5[illegible]
			16.470	22.990
			24.700	16.800
			32.420	16.920
			32.940	16.700
			41.170	16.740
			49.410	16.650
			57.640	16.740
			65.870	16.700
			66.390	177.8[illegible]

			74.110	208.870
			82.340	77.720
			90.590	53.420
			98.810	32.400
POWR	0000	105	98.810	17.820
			0.000	30.620
			8.230	25.770
			16.470	16.850
			24.700	13.270
			32.420	13.050
			32.940	13.010
			41.170	13.030
			49.410	13.010
			57.640	13.000
			65.870	13.010
			66.390	13.250
			74.110	13.400
			82.340	19.930
			90.590	26.900
			98.810	30.620
POWR	0000	107	98.810	11.030
			0.000	3.710
			8.230	3.640
			16.470	12.600
			24.700	87.110
			32.420	25.740
			32.940	1.790
			41.170	1.770
			49.410	1.760
			57.640	1.770
			65.870	1.780
			66.390	1.820
			74.110	1.830
			82.340	2.540
			90.590	3.390
			98.810	3.770
POWR	0000	108	98.810	16.270
			0.000	1.550
			8.230	1.390
			16.470	1.050
			24.700	0.730
			32.420	0.750
			32.940	0.680
			41.170	0.690
			49.410	0.670
			57.640	0.680
			65.870	0.680
			66.390	[illegible]
			74.110	64.150
			82.340	71.980
			90.590	48.460
			98.810	1.550
POWR	0000	- 109	98.810	6.550
			0.000	10.310
			8.230	9.110
			16.470	7.020
			24.700	5.100
			32.420	5.050
			32.940	5.010
			41.170	5.010
			49.410	5.010

			57.640	5.010
			65.870	5.010
			66.390	5.250
			74.110	5.190
			82.340	7.270
			90.580	9.370
			98.810	10.310
POWR	0000	110	98.810	13.430
			0.000	50.770
			8.230	41.700
			16.470	6.040
			24.700	0.600
			32.420	1.000
			32.940	0.050
			41.170	0.050
			49.410	0.060
			57.640	0.060
			65.870	0.050
			66.390	0.300
			74.110	1.170
			82.340	17.620
			90.580	42.510
			98.810	50.770
POWR	0000	112	98.810	2.400
			0.000	5.800
			8.230	5.030
			16.470	2.750
			24.700	3.460
			32.420	5.860
			32.940	0.180
			41.170	0.190
			49.410	0.190
			57.640	0.150
			65.870	0.150
			66.390	0.440
			74.110	0.560
			82.340	2.640
			90.580	4.980
			98.810	5.800
POWR	0000	113	98.810	5.090
			0.000	17.050
			8.230	14.930
			16.470	8.950
			24.700	3.530
			32.420	4.400
			32.940	0.150
			41.170	0.150
			49.410	0.170
			57.640	0.150
			65.870	0.150
			66.390	0.710
			74.110	1.630
			82.340	9.090
			90.580	14.970
			98.810	17.050
POWR	0000	116	98.810	129.490
			0.000	97.350
			8.230	132.220
			16.470	131.260
			24.700	125.120
			32.420	104.030

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			32.940	17.000
			41.170	17.550
			49.410	17.750
			57.670	9.880
			65.870	9.200
			66.390	9.390
			74.110	19.670
			82.340	47.600
			90.590	87.140
			98.810	97.390
POWR	0000	117	98.810	72.800
			0.000	35.700
			8.230	157.330
			16.470	161.600
			24.700	144.660
			32.420	182.950
			32.940	15.150
			41.170	15.200
			49.410	15.060
			57.640	15.200
			65.870	15.170
			66.390	32.380
			74.110	67.330
			82.340	58.380
			90.590	68.360
			98.810	35.700
POWR	0000	118	98.810	77.600
			0.000	15.150
			8.230	21.140
			16.470	17.750
			24.700	19.910
			32.420	23.950
			32.940	20.210
			41.170	20.930
			49.410	16.320
			57.640	11.790
			65.870	10.940
			66.390	19.210
			74.110	40.950
			82.340	52.930
			90.590	50.470
			98.810	15.150
POWR	0000	121	98.810	87.770
			0.000	107.720
			8.230	103.140
			16.470	91.850
			24.700	81.800
			32.420	173.330
			32.940	35.910
			41.170	55.920
			49.410	35.920
			57.640	55.990
			65.870	35.910
			66.390	172.690
			74.110	92.850
			82.340	93.420
			90.590	104.520
			98.810	107.720
POWR	0000	130	98.810	26.380
			0.000	7.330
			8.230	18.020

			16.470	118.650
			24.700	119.250
			32.420	36.380
			32.940	3.440
			41.170	3.410
			49.410	3.390
			57.640	3.410
			65.870	3.430
			66.390	8.340
			74.110	6.490
			82.340	6.990
			90.580	8.710
			98.810	7.320
POWR	0000	131	98.810	28.800
			0.000	18.690
			8.230	16.750
			16.470	12.720
			24.700	8.820
			32.420	9.260
			32.940	8.730
			41.170	8.730
			49.410	8.730
			57.640	8.720
			65.870	8.720
			66.390	174.190
			74.110	211.340
			82.340	54.800
			90.580	27.340
			98.810	18.690
POWR	0000	187	98.810	1172.020
			0.000	1614.780
			8.230	1315.440
			16.470	1102.570
			24.700	1105.370
			32.420	1410.790
			32.940	569.740
			41.170	359.550
			49.410	589.650
			57.640	589.540
			65.870	569.740
			66.390	2140.190
			74.110	1567.670
			82.340	1602.970
			90.580	1741.070
			98.810	1614.780

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EFFECTIVE RADIATION COUPLINGS (ε=.02)

RAD	0020	16.200	[illegible]	[illegible]	0	0	0
RAD	0020	14.400	105	5	0	0	0
RAD	0020	7.690	109	9	0	0	0
RAD	0020	5.600	110	10	0	0	0
RAD	0020	17.040	103	3	0	0	0
RAD	0020	17.040	104	4	0	0	0
RAD	0020	10.810	112	12	0	0	0
RAD	0020	8.420	113	13	0	0	0
RAD	0020	6.730	107	7	0	0	0
RAD	0020	6.730	108	8	0	0	0
RAD	0020	19.690	116	16	0	0	0
RAD	0020	16.760	117	17	0	0	0
RAD	0020	16.760	118	[illegible]	0	0	0
RAD	0020	16.680	121	21	0	0	0
RAD	0020	0.720	22	60	0	0	0
RAD	0020	0.270	22	61	0	0	0
RAD	0020	0.720	22	62	0	0	0
RAD	0020	1.380	22	63	0	0	0
RAD	0020	2.420	22	270	0	0	0
GENERATED NODE		270					
RAD	0020	1.380	22	65	0	0	0
RAD	0020	0.720	22	66	0	0	0
RAD	0020	0.270	22	[illegible]	0	0	0
RAD	0020	0.720	22	68	0	0	0
RAD	0020	1.470	130	50	0	0	0
RAD	0020	2.090	130	51	0	0	0
RAD	0020	1.470	130	52	0	0	0
RAD	0020	1.710	130	53	0	0	0
RAD	0020	2.420	130	54	0	0	0
RAD	0020	1.710	130	55	0	0	0
RAD	0020	1.470	130	56	0	0	0
RAD	0020	2.090	130	57	0	0	0
RAD	0020	1.470	130	58	0	0	0
RAD	0020	1.470	131	250	0	0	0
RAD	0020	2.090	131	251	0	0	0
RAD	0020	1.470	131	252	0	0	0
RAD	0020	1.710	131	253	0	0	0
RAD	0020	2.420	131	254	0	0	0
RAD	0020	1.710	131	255	0	0	0
RAD	0020	1.470	131	256	0	0	0
RAD	0020	2.090	131	257	0	0	0
RAD	0020	1.470	131	238	0	0	0

CONDUCTION COUPLINGS

COND	0010	5. 400	[illegible]	[illegible]	0	0	0
COND	0010	5. 400	61	62	0	0	0
COND	0010	5. 400	[illegible]	[illegible]	0	0	0
COND	0010	5. 400	67	68	0	0	0
COND	0010	9. 060	69	70	0	0	0
COND	0010	9. 060	70	71	0	0	0
COND	0010	10. 820	75	75	0	0	0
COND	0010	10. 820	[illegible]	77	0	0	0
COND	0010	5. 400	[illegible]	77	0	0	0
COND	0010	5. 400	79	80	0	0	0
COND	0010	5. 400	84	85	0	0	0
COND	0010	5. 400	[illegible]	[illegible]	0	0	0
COND	0010	10. 820	67	88	0	0	0
COND	0010	10. 820	[illegible]	89	0	0	0
COND	0010	9. 060	73	84	0	0	0
COND	0010	9. 060	74	[illegible]	0	0	0
COND	0010	7. 800	60	[illegible]	0	0	0
COND	0010	7. 800	62	65	0	0	0
COND	0010	7. 800	63	65	0	0	0
COND	0010	7. 800	65	[illegible]	0	0	0
COND	0010	7. 540	66	69	0	0	0
COND	0010	13. 650	67	70	0	0	0
COND	0010	7. 540	[illegible]	[illegible]	0	0	0
COND	0010	6. 540	69	72	0	0	0
COND	0010	6. 540	71	74	0	0	0
COND	0010	6. 000	72	75	0	0	0
COND	0010	6. 000	72	77	0	0	0
COND	0010	6. 720	73	78	0	0	0
COND	0010	12. 110	[illegible]	79	0	0	0
COND	0010	6. 720	77	[illegible]	0	0	0
COND	0010	7. 800	[illegible]	[illegible]	0	0	0
COND	0010	7. 800	80	83	0	0	0
COND	0010	7. 800	[illegible]	[illegible]	0	0	0
COND	0010	7. 800	[illegible]	86	0	0	0
COND	0010	6. 720	[illegible]	87	0	0	0
COND	0010	12. 110	85	[illegible]	0	0	0
COND	0010	6. 720	[illegible]	[illegible]	0	0	0
COND	0010	6. 720	87	90	0	0	0
COND	0010	6. 720	89	[illegible]	0	0	0
COND	0010	6. 540	90	[illegible]	0	0	0
COND	0010	6. 540	72	95	0	0	0
COND	0010	7. 540	93	60	0	0	0
COND	0010	13. 650	94	61	0	0	0
COND	0010	7. 540	95	62	0	0	0
COND	0010	16. 960	[illegible]	[illegible]	0	0	0
COND	0010	14. 420	231	63	0	0	0
COND	0010	14. 660	[illegible]	91	0	0	0
COND	0010	11. 380	257	92	0	0	0
COND	0010	18. 210	55	72	0	0	0
COND	0010	16. 320	235	74	0	0	0
COND	0010	18. 210	[illegible]	90	0	0	0
COND	0010	16. 320	[illegible]	92	0	0	0
COND	0010	11. 800	[illegible]	93	0	0	0
COND	0010	7. 110	50	60	0	0	0
COND	0010	10. 630	250	95	0	0	0
COND	0010	6. 070	250	62	0	0	0
COND	0010	7. 110	52	[illegible]	0	0	0
COND	0010	11. 800	52	[illegible]	0	0	0
COND	0010	6. 070	252	68	0	0	0
COND	0010	10. 630	252	[illegible]	0	0	0

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COND	0010	13.540	59	73	0	0	0
COND	0010	6.170	[illegible]	[illegible]	0	0	0
COND	0010	12.310	238	77	0	0	0
COND	0010	4.820	236	[illegible]	0	0	0
COND	0010	6.170	56	94	0	0	0
COND	0010	13.540	[illegible]	97	0	0	0
COND	0010	4.820	256	86	0	0	0
COND	0010	12.310	256	89	0	0	0
COND	0010	19.900	[illegible]	[illegible]	0	0	0
COND	0010	19.900	[illegible]	[illegible]	0	0	0
COND	0010	19.900	56	57	0	0	0
COND	0010	19.900	57	58	0	0	0
COND	0010	14.850	[illegible]	[illegible]	0	0	0
COND	0010	14.850	[illegible]	[illegible]	0	0	0
COND	0010	14.850	[illegible]	55	0	0	0
COND	0010	14.850	35	58	0	0	0
COND	0010	9.950	250	251	0	0	0
COND	0010	9.950	251	252	0	0	0
COND	0010	9.950	[illegible]	237	0	0	0
COND	0010	9.950	257	258	0	0	0
COND	0010	7.430	250	253	0	0	0
COND	0010	7.430	252	256	0	0	0
COND	0010	7.430	252	255	0	0	0
COND	0010	7.430	255	258	0	0	0
COND	0010	1.350	1	[illegible]	0	0	0
COND	0010	1.350	1	[illegible]	0	0	0
COND	0010	1.350	1	[illegible]	0	0	0
COND	0010	1.080	[illegible]	2	0	0	0
COND	0010	0.870	1	[illegible]	0	0	0
COND	0010	1.000	[illegible]	[illegible]	0	0	0
COND	0010	1.000	[illegible]	4	0	0	0
COND	0010	1.550	2	[illegible]	0	0	0
COND	0010	1.550	2	[illegible]	0	0	0
COND	0010	0.900	[illegible]	3	0	0	0
COND	0010	3.080	2	3	0	0	0
COND	0010	3.080	2	4	0	0	0
COND	0010	1.150	[illegible]	9	0	0	0
COND	0010	1.180	5	[illegible]	0	0	0
COND	0010	1.090	5	[illegible]	0	0	0
COND	0010	1.090	[illegible]	4	0	0	0
COND	0010	1.850	6	[illegible]	0	0	0
COND	0010	2.800	[illegible]	[illegible]	0	0	0
COND	0010	2.800	6	[illegible]	0	0	0
COND	0010	2.800	6	[illegible]	0	0	0
COND	0010	0.560	[illegible]	3	0	0	0
COND	0010	0.560	[illegible]	4	0	0	0
COND	0010	1.880	9	10	0	0	0
COND	0010	0.710	[illegible]	[illegible]	0	0	0
COND	0010	0.710	[illegible]	4	0	0	0
COND	0010	1.590	[illegible]	[illegible]	0	0	0
COND	0010	2.200	[illegible]	[illegible]	0	0	0
COND	0010	0.400	10	[illegible]	0	0	0
COND	0010	-0.400	10	[illegible]	0	0	0
COND	0010	1.520	[illegible]	[illegible]	0	0	0
COND	0010	2.700	[illegible]	[illegible]	0	0	0
COND	0010	2.700	11	[illegible]	0	0	0
COND	0010	2.700	11	[illegible]	0	0	0
COND	0010	0.380	[illegible]	[illegible]	0	0	0
COND	0010	0.380	[illegible]	4	0	0	0
COND	0010	0.350	11		0	0	0
COND	0010	0.350	[illegible]	6	0	0	0

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COND	0010	1.360	12	13	0	0	0
COND	0010	2.020	12	14	0	0	0
COND	0010	0.870	12	7	0	0	0
COND	0010	0.870	12	8	0	0	0
COND	0010	2.520	14	13	0	0	0
COND	0010	4.170	14	73	0	0	0
COND	0010	4.170	14	76	0	0	0
COND	0010	4.170	14	77	0	0	0
COND	0010	1.430	13	15	0	0	0
COND	0010	1.020	13	[illegible]	0	0	0
COND	0010	0.670	13	7	0	0	0
COND	0010	0.670	13	8	0	0	0
COND	0010	0.900	15	16	0	0	0
COND	0010	1.980	15	72	0	0	0
COND	0010	1.980	15	74	0	0	0
COND	0010	1.250	15	7	0	0	0
COND	0010	1.250	15	8	0	0	0
COND	0010	1.000	15	[illegible]	0	0	0
COND	0010	1.000	15	18	0	0	0
COND	0010	0.610	[illegible]	[illegible]	0	0	0
COND	0010	1.500	16	17	0	0	0
COND	0010	1.500	16	19	0	0	0
COND	0010	0.860	16	20	0	0	0
COND	0010	1.470	19	72	0	0	0
COND	0010	1.470	19	74	0	0	0
COND	0010	3.360	19	[illegible]	0	0	0
COND	0010	3.360	19	[illegible]	0	0	0
COND	0010	1.620	20	69	0	0	0
COND	0010	1.620	20	70	0	0	0
COND	0010	1.620	20	71	0	0	0
COND	0010	3.620	20	21	0	0	0
COND	0010	1.210	[illegible]	[illegible]	0	0	0
COND	0010	2.800	[illegible]	[illegible]	0	0	0
COND	0010	1.210	[illegible]	9	0	0	0
COND	0010	2.800	8	19	0	0	0
COND	0010	1.110	3	[illegible]	0	0	0
COND	0010	0.980	3	53	0	0	0
COND	0010	1.800	3	56	0	0	0
COND	0010	1.110	[illegible]	250	0	0	0
COND	0010	0.980	[illegible]	253	0	0	0
COND	0010	1.800	[illegible]	256	0	0	0
COND	0010	3.080	[illegible]	56	0	0	0
COND	0010	2.680	[illegible]	57	0	0	0
COND	0010	1.040	[illegible]	58	0	0	0
COND	0010	3.080	8	256	0	0	0
COND	0010	2.680	8	257	0	0	0
COND	0010	1.040	8	258	0	0	0
COND	0010	0.950	17	55	0	0	0
COND	0010	0.720	17	52	0	0	0
COND	0010	0.940	18	233	0	0	0
COND	0010	0.720	18	232	0	0	0
MASS	0010	0.180	101	103	104	0	0
MASS	0010	_0.170	117	118	121	130	131
MASS	0010	0.150	105	0	0	0	0
MASS	0010	0.070	109	0	0	0	0
MASS	0010	0.060	110	0	0	0	0
MASS	0010	0.110	112	0	0	0	0
MASS	0010	0.090	113	22	0	0	0
MASS	0010	0.070	107	108	0	0	0
MASS	0010	0.210	116	0	0	0	0
MASS	0010	2.230	[illegible]	[illegible]	0	0	0

MASS	0010	1.970	2	0	0	0	0
MASS	0010	2.340	3	4	0	0	0
MASS	0010	1.970	5	0	0	0	0
MASS	0010	0.990	[illegible]	0	0	0	0
MASS	0010	0.930	7	8	0	0	0
MASS	0010	1.060	9	0	0	0	0
MASS	0010	0.770	10	0	0	0	0
MASS	0010	1.000	11	0	0	0	0
MASS	0010	1.490	12	0	0	0	0
MASS	0010	1.150	13	0	0	0	0
MASS	0010	0.520	14	0	0	0	0
MASS	0010	1.680	15	0	0	0	0
MASS	0010	2.710	16	0	0	0	0
MASS	0010	2.300	17	18	0	0	0
MASS	0010	2.260	19	0	0	0	0
MASS	0010	1.550	20	0	0	0	0
MASS	0010	2.290	21	0	0	0	0
MASS	0010	3.240	[illegible]	52	56	58	0
MASS	0010	4.600	51	57	0	0	0
MASS	0010	3.750	53	55	0	0	0
MASS	0010	0.001	54	234	0	0	0
MASS	0010	0.790	[illegible]	52	[illegible]	68	78
MASS	0010	0.790	[illegible]	84	86	0	0
MASS	0010	1.400	[illegible]	[illegible]	79	80	0
MASS	0010	1.520	[illegible]	63	91	83	0
MASS	0010	2.660	[illegible]	0	0	0	0
MASS	0010	1.030	[illegible]	71	93	95	0
MASS	0010	1.820	[illegible]	[illegible]	0	0	0
MASS	0010	1.510	72	74	90	92	0
MASS	0010	0.001	75	92	[illegible]	0	0
MASS	0010	1.300	73	[illegible]	97	89	0
MASS	0010	2.300	[illegible]	[illegible]	0	0	0
MASS	0010	1.620	230	232	256	258	0
MASS	0010	2.300	231	257	0	0	0
MASS	0010	1.880	232	235	0	0	0

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VARIABLE DATA

COND	0010	6.000	[illegible]	270	0	0	0
MASS	0010	1.540	[illegible]	0	0	0	[illegible]
MASS	0010	5.320	[illegible]	[illegible]	0	0	0
MASS	0010	2.660	234	0	[illegible]	0	0
COND	0011	0.381	[illegible]	271	0	0	0
GENERATED NODE		271					
COND	0011	0.381	[illegible]	271	0	0	0
COND	0011	0.381	[illegible]	271	0	0	[illegible]
COND	0011	0.381	[illegible]	271	0	0	[illegible]
TEMP	0020	15.000	[illegible]	0	[illegible]	0	[illegible]
POWR	0000	270	0.000	1.200			
TEMP	0010	4.000	188	0	0	0	0
COND	0010	13.670	[illegible]	[illegible]	0	0	[illegible]
COND	0010	13.670	[illegible]	[illegible]	[illegible]	0	0
COND	0010	12.520	[illegible]	[illegible]	[illegible]	0	0
COND	0010	12.520	64	[illegible]	[illegible]	0	0
COND	0010	23.040	[illegible]	[illegible]	54	55	0
COND	0010	21.080	54	[illegible]	54	51	[illegible]
COND	0010	11.520	[illegible]	253	234	255	0
COND	0010	10.540	234	257	254	251	[illegible]

APPENDIX F. DTM THERMAL ANALYSIS RESULTS

OAO CORPORATION

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(301) 937-3090

MEMORANDUM
LDTHER-IOM-81-006
June 22, 1981

TO : D. Mengers

FROM : A. Melak

SUBJECT: Thermal Analyses of the Dummy Thematic Mapper

REFERENCE: OAOCO, LDTHER-IOM-81-005, Thermal Model Developed for the Dummy Thematic Mapper, A. Melak, June 1981

This memorandum describes the analyses and parametrics performed on the Landsat-D Dummy Thematic Mapper (DTM) model described in reference 1. The objective of the DTM in the satellite is to simulate the thermal characteristics of the Thematic Mapper (TM). Critical areas of concern are the temperature gradients across the mounting feet which attach the DTM (at nodes 50, 52, 56, and 58) to the mission adapter portion of the Landsat-D instrument module (I/M) and node 64 where the Attitude Determination Sensor Assembly (ADSA) is mounted. Analyses were conducted to determine the expected temperature levels and thermal design sensitivities of the DTM. Parametrics were performed with the heaters to determine the optimum size and position for controlling the critical areas. All analyses were accomplished using the Simplified Shuttle Payload Thermal Analyzer (SSPTA).

The I/M (node 271) was treated as a constant temperature node with a possible temperature range from 10°C to 30°C. The ADSA is an insulated box with a constant power of 1.2 watts.

Initially a steady state temperature distribution in the main frame was dtermined for environmental fluxes corresponding to the beta angle (β) limits of 23.4° and 41.8°. The I/M was fixed at 15°C, the heaters were assumed off and the insulation effective emittance was assumed to be 0.02. For β = 23.4 the temperature distribution within the main frame was from -5.6°C to -6.2°C (ΔT = .6°C). For β = 41.8° the distribution was from -4.9°C to -4.3°C (ΔT = .6°C).

Results from a much smaller model of the DTM indicated that for the conditions stated above an additional 30 watts of power is needed to maintain a temperature of 15°C in the main frame. This was checked using the detailed model. Four heaters were used to control the critical areas. Seven and one-half watt heaters were placed on either side of the ADSA at nodes 61 and 67. To control the gradients across the mounting feet 7.5 watt heaters were placed between the feet at nodes 53 and 55. For the same initial conditions and β = 23.4° the steady

state temperature distribution was from $14.3^{o}C$ to $15.7^{o}C$ ($\Delta T = 1.4^{o}C$). For $\beta = 41.8^{o}$ the distribution was from $15.4^{o}C$ to $16.9^{o}C$ ($\Delta T = 1.5^{o}C$). These results confirm that 30 watts is the nominal power needed for flight. The steady state results indicate that no severe thermal gradients exist in the main frame and that the DTM is fairly insensitive to β angle. All further analyses used a β angle of 23.4^{o}.

Parametrics were performed to determine temperature versus heater power for various temperatures of the I/M and insulation effective emittances. The results shown in Figure 1 indicate the temperature of the DTM will remain within the limits over the range of design variables. Node 64 was used since it is one of the critical areas and representative of the main frame.

Steady state parametrics were performed to assess the effects of the distribution of heater power. Two cases were assumed. One represents an even distribution of power at the four heater locations and the other represents a fixed 15 watts of power at the ADSA and a variable, thermostatically controlled power at the mounting feet. From Figure 1 a heater power of approximately 18 watts is needed to maintain a temperature of $15^{o}C$ in the main frame with the following conditions; I/M = $30^{o}C$ and $\epsilon = 0.02$. For 4.5 watts of power at nodes 53, 55, 61 and 67 (18 watts total) the temperature at node 64 was $15.3^{o}C$. With the same conditions but 7.5 watts at nodes 61 and 67 and 1.5 watts at nodes 53 and 55, the temperature at node 64 was $15.5^{o}C$.

From Figure 1 a heater power of 34 watts is needed to maintain $15^{o}C$ with the following conditions; I/M = $10^{o}C$ and $\epsilon = 0.02$. For 8.5 watts at nodes 53, 55, 61 and 67 the temperature for node 64 was $15.7^{o}C$. With 7.5 watts at nodes 61 and 67 and 9.5 watts at nodes 53 and 55, node 64 had a temperature of $15.5^{o}C$. These results indicate that the DTM is conductively well coupled and therefore insensitive to power distribution.

To simulate a heater/thermostat system failure leaving full power on, 25 watts of power were added at nodes 61 and 67 with a hot I/M (I/M = $30^{o}C$) and an effective emittance of 0.02. This resulted in a steady state temperature of $34.6^{o}C$ for node 64 which is above the desired limit. A more effective insulation would increase this temperature. Figure 1 shows that for an $\epsilon = .01$ the temperature will be slightly above $50^{o}C$.

Figure 2 shows the transient temperature response of node 64 with 13.6 watts at nodes 53, 55, 61 and 67 (54.4 watts total). The initial temperature was assumed to be $15^{o}C$ and the insulation effective emittance was 0.02. This analysis is intended to represent the DTM with thermostatic set points of $15^{o}C$ and $20^{o}C$. With I/M = $30^{o}C$, one complete heat-up and cool down requires approximately 20.2 hours. For I/M = $10^{o}C$ the cycle requires approximately 24.5 hours.

In conclusion the DTM is fairly insensitive to β angle and power distribution but is sensitive to the insulation effectiveness. The thermal response of the DTM for various conditions can be found in Figure 1. This analysis confirms previous analysis indicating a nominal power of 30 watts is necessary for flight.

A. Melak

A. Melak

Attachments

/egc

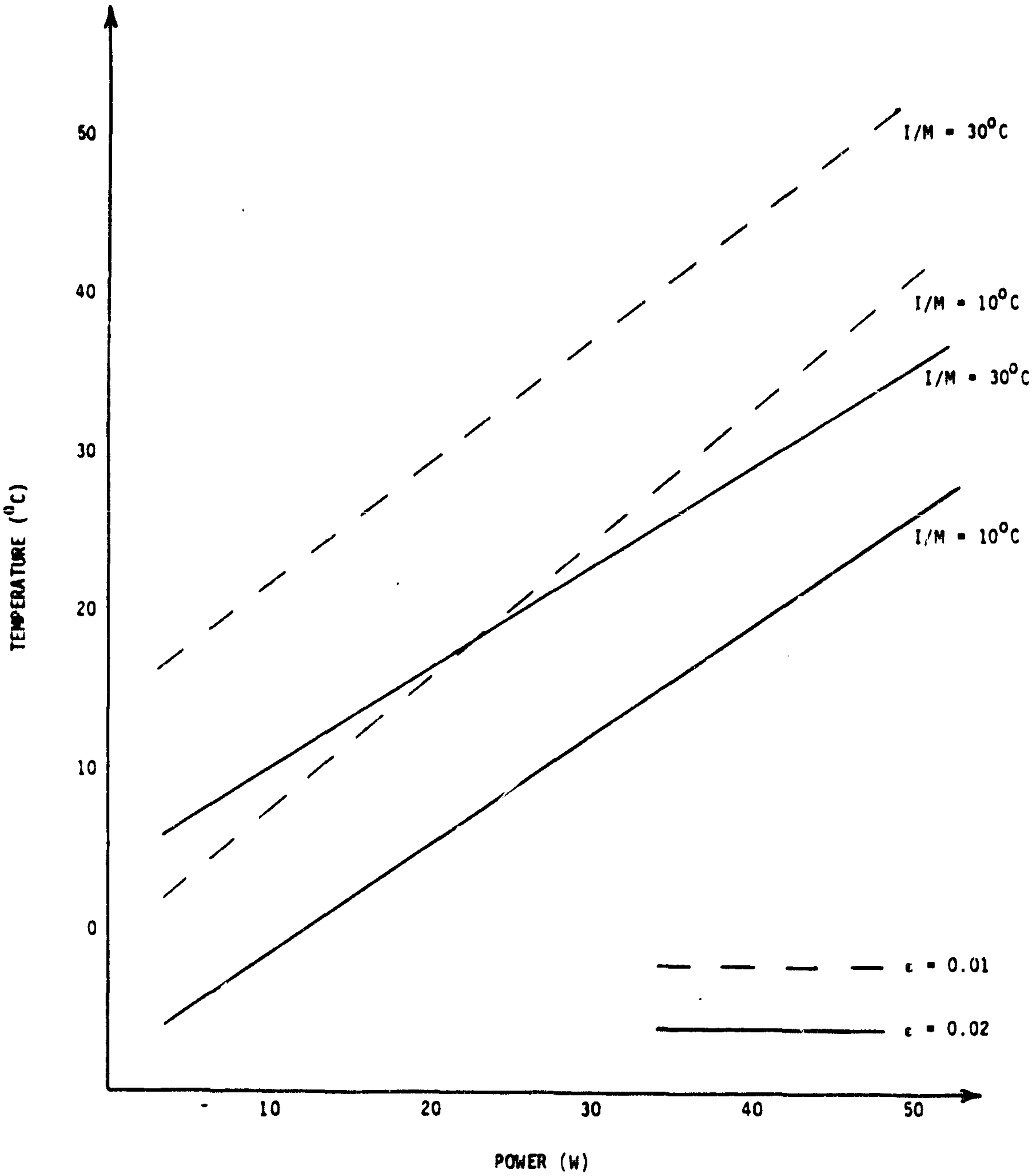

Figure 1. Temperature vs. Power for Insulation Effectiveness of 0.01 and 0.02

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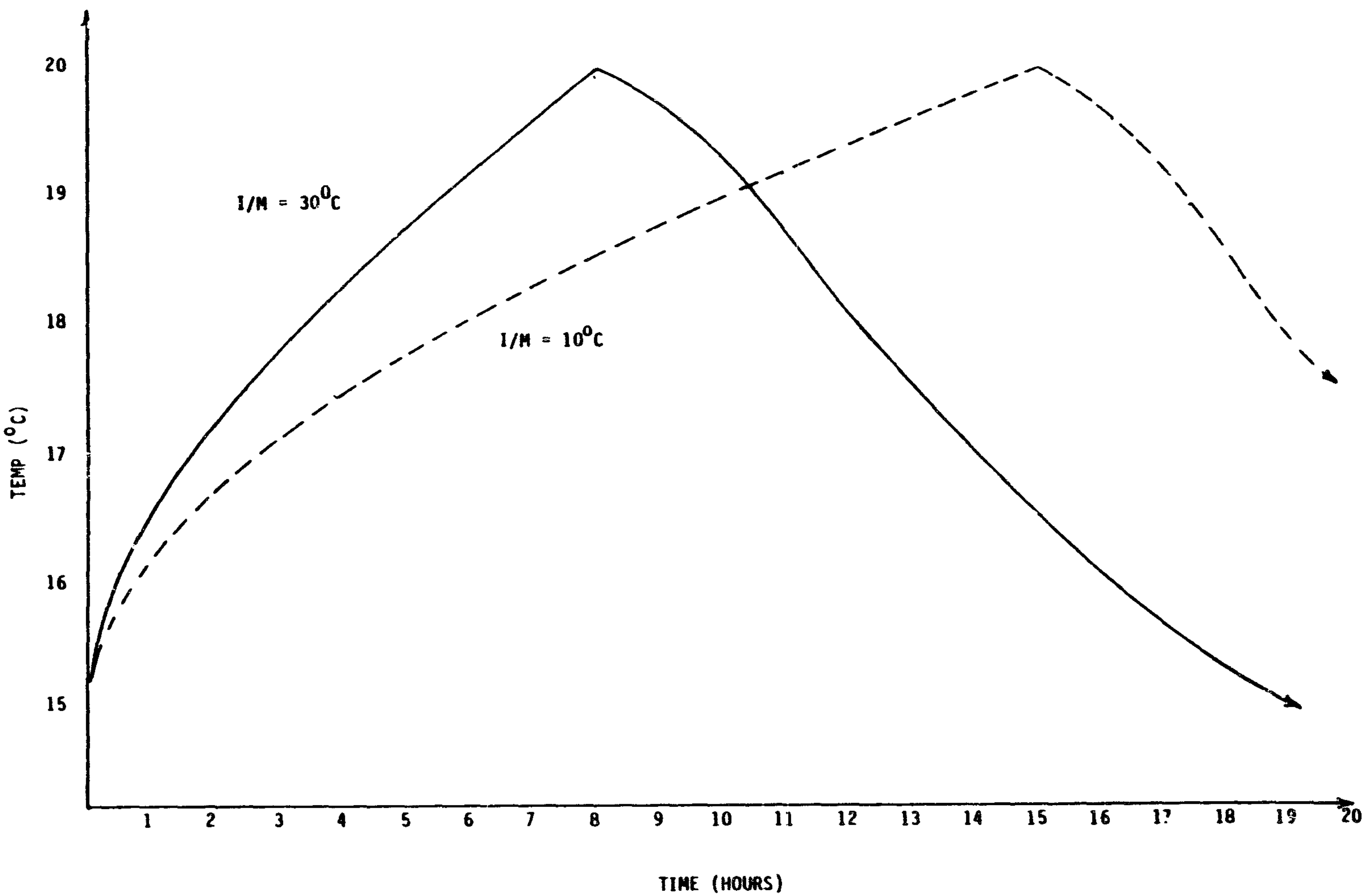

Figure 2. Temperature vs. Time for Node 64 with 54.4 Watts of Power

APPENDIX G. LANDSAT-D HARDLINE HEATER ANALYSIS

MEMORANDUM
LDTHER-IOM-81-004
May 20, 1981

OAO CORPORATION

TO : Dave Mengers

FROM : Doan Eiband

SUBJECT: Landsat-D Retrieval Thermal Safety Analysis; Hardline Heaters Failed On

References: 1. Arthur D. Little Incorporated, C-83198-01, Environmental Flux Study for the Landsat-D Spacecraft, J.T. Bartoszek and W.J. Raymond, March 1980

This study was conducted to determine the transient temperature response of the major Landsat-D Spacecraft components if all of the hardline heaters failed on while it is in the orbiter bay. In addition to the temperature profiles, two other parameters of interest were determined. They were the time to reach the component maximum safe retrieval temperature and the component temperature rate of change at the time the limit temperature was reached.

The model used in this analysis was developed from two other thermal models. They are the MMS model previously generated for the MMS Project Office and the Landsat-D model of reference 1. The MMS model component radiation couplings, conduction couplings, and thermal inertias were used directly in this model. The only modifications made were to change the radiation couplings to space to radiation couplings to an STS/EARTH boundary. The Landsat-D instrument module component radiation couplings, conduction couplings, and thermal inertias were taken from reference 1 for this model. The radiation couplings to space for the insulated surfaces were scaled by the effective emittance of the insulation blanket to approximate the radiation transfer between an internal node and a boundary node without having to explicitly solve for the external temperature of the blanket. These couplings were then coupled to the STS/EARTH boundary.

Using this reduced model, the component temperature profiles were found by applying the appropriate boundary temperatures, initial component temperatures, and component heater power conditions. These conditions were as follows. The boundary to which the surface nodes radiated was assumed to be a black cavity at -5^{o}C. This temperature corresponds to the steady state value for the orbiter in a solely earth viewing attitude. The initial component temperatures were assumed to be 20^{o}C. The component heater powers were those for a nominal supply voltage of 28V and were assumed constant throughout the analysis.

The results of the analysis are given in Table 1 and the description of the model, in the Nodal Network Thermal Balance computer program format, is found in Appendix A.

Doan Eiband

Doan Eiband

/bsg

Table 1. Landsat-D Retrieval Analysis

Node	Description	Temp. Limit (°C)	Time to Limit (HRS)	$\Delta T/\Delta\tau$ (°C/HR)	Steady State Temp. (°C)
1	Triangular Transition Adapter	50	15	2.0	70
2	Multimission Modular Spacecraft Structure	50	22	1.2	60
3	Secondary Propulsion Tank 1	50	10	2.7	92
4	Communications and Data Handling Module	50	19	1.3	59
5	Communications and Data Handling Module Sun Shield	50	*	*	34
6	Modular Attitude Control System	50	15	1.9	66
7	Modular Attitude Control System Sun Shield	50	*	*	38
8	Mission Power Supply	40	*	*	38

* Steady State Temperature does not exceed temperature limit

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Table 1. Landsat-D Retrieval Analysis (Cont.)

Node	Description	Temp. Limit (^{o}C)	Time to Limit (HRS)	$\Delta T/\Delta\tau$ ($^{o}C/HR$)	Steady State Temp. (^{o}C)
9	Propulsion Module	50	9	3.7	112
10	Earth Sensor Assembly Module	50	*	*	19
11	Signal Conditioning and Control Unit	50	*	*	32
12	Mission Adapter	40	7	2.2	73
13	Mission Adapter Radiator	40	5	2.4	73
14	Instrument Module Strongback	40	9	2.0	72
15	Instrument Module Upper Support Structure (+Y, -X)	40	7	2.1	70
16	Instrument Module Panel (+Y, -X)	40	5	2.1	67
17	S-Band Panel	40	3	3.4	79

* Steady State Temperature does not exceed temperature limit

OAO CORPORATION

Table 1. Landsat-D Retrieval Analysis (Cont.)

Node	Description	Temp. Limit (^{o}C)	Time to Limit (HRS)	$\Delta T/\Delta\tau$ ($^{o}C/HR$)	Steady State Temp. (^{o}C)
18	Instrument Module Upper Support Structure (+Y, +X)	40	9	1.9	69
19	Instrument Module Panel (+Y, +X)	40	7	2.0	68
20	Instrument Module Upper Support Structure (-Y, -X)	40	10	2.1	72
21	Instrument Module Panel (-Y, -X)	40	6	2.4	82
22	Instrument Module Upper Support Structure (-Y, +X)	40	9	2.0	71
23	Instrument Module Panel (-Y, +X)	40	4	2.5	73
24	Antenna Boom Pedestal	88	*	*	52
25	Wide-Band Module Mount	40	1	0.9	60

* Steady State Temperature does not exceed temperature limit

Table 1. Landsat-D Retrieval Analysis (Cont.)

Node	Description	Temp. Limit (^oC)	Time to Limit (HRS)	$\Delta T/\Delta\tau$ (^oC)	Steady State Temp. (^oC)
26	Wide Band Module	46	*	*	22
27	Multi-Spectral Scanner Mount	40	10	1.3	67
28	Multi-Spectral Scanner	40	10	1.0	61
29	Thematic Mapper	40	*	*	14
30	Truss Assembly	50	*	*	-1
31	Module Attitude Control System Star Trackers	50	6	5.1	96
32	Rocket Engine Modules (Propulsion Module)	150	6	11.3	227

* Steady State Temperature does not exceed temperature limit

SINGLE ARRAY INPUTS

N	EPSO	ARR	SFS	ER	WCP	P	COR	TZERO	ALPHA	ERTH	ALB
1	0.000	0.000	0.000	0.000	8.500	0.000	0.000	473.690	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	33.800	0.000	0.000	473.690	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	15.000	106.000	0.000	473.690	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	68.500	696.000	0.000	473.690	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.500	0.000	0.000	473.690	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	103.000	875.000	0.000	473.690	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.500	0.000	0.000	473.690	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	137.000	686.000	0.000	473.690	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	38.400	266.000	0.000	473.690	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	6.900	0.000	0.000	473.690	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	12.600	0.000	0.000	473.690	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	24.200	250.000	0.000	473.690	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	9.700	171.000	0.000	473.690	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	9.900	0.000	0.000	473.690	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	7.600	0.000	0.000	473.690	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	2.760	74.000	0.000	473.690	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	3.200	112.000	0.000	473.690	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	6.400	0.000	0.000	473.690	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	9.900	130.000	0.000	473.690	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	11.700	0.000	0.000	473.690	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	3.400	55.600	0.000	473.690	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	6.400	0.000	0.000	473.690	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	5.000	121.000	0.000	473.690	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	1.200	30.000	0.000	473.690	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.460	88.000	0.000	473.690	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	40.600	0.000	0.000	473.690	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	2.400	144.000	0.000	473.690	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	29.900	0.000	0.000	473.690	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	127.000	0.000	0.000	473.690	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	4.600	0.000	0.000	473.690	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	8.600	122.000	0.000	473.690	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	4.200	266.000	0.000	473.690	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	1000.000	0.000	0.000	482.690	0.000	0.000	0.000

DOUBLE ARRAY INPUTS

NO.	N	M	COND(N,M)	COND(M,N)
1	1	2	1.680000	1.680000
2	1	12	9.360000	9.360000
3	2	3	1.000000	1.000000
4	2	4	5.400000	5.400000
5	2	6	5.400000	5.400000
6	2	8	5.840000	5.840000
7	2	9	1.460000	1.460000
8	2	10	0.410000	0.410000
9	2	11	1.000000	1.000000
10	12	13	5.000000	5.000000
11	12	14	5.140000	5.140000
12	12	29	1.520000	1.520000
13	12	30	0.120000	0.120000
14	14	15	1.760000	1.760000
15	14	20	1.760000	1.760000
16	14	24	0.236000	0.236000
17	15	16	1.790000	1.790000
18	15	17	1.980000	1.980000
19	15	18	2.860000	2.860000
20	15	20	1.000000	1.000000
21	15	25	0.190000	0.190000
22	15	30	0.120000	0.120000
23	18	19	1.790000	1.790000
24	18	22	1.000000	1.000000
25	18	27	0.270000	0.270000
26	20	21	1.790000	1.790000
27	20	22	2.860000	2.860000
28	20	25	0.190000	0.190000
29	20	30	0.120000	0.120000
30	22	23	1.790000	1.790000
31	22	27	0.270000	0.270000
32	25	26	1.410000	1.410000
33	27	28	12.410000	12.410000
34	9	32	0.400000	0.400000
35	6	31	0.770000	0.770000

NO.	N	M	SFA(N,M)	SFA(M,N)
1	1	33	0.083000	0.083000
2	2	33	0.151000	0.151000
3	4	5	11.500000	11.500000
4	5	33	10.300000	10.300000
5	6	7	11.500000	11.500000
6	7	33	10.300000	10.300000
7	8	33	12.450000	12.450000
8	9	33	0.700000	0.700000
9	10	33	0.800000	0.800000
10	11	33	0.800000	0.800000
11	4	33	0.125000	0.125000
12	6	33	0.148000	0.148000
13	2	3	0.490000	0.490000
14	2	4	0.160000	0.160000
15	2	6	0.160000	0.160000
16	2	8	0.160000	0.160000
17	12	33	0.050000	0.050000
18	13	33	1.030000	1.030000
19	14	33	0.030000	0.030000

NO.	N	M	SFA(N,M)	SFA(M,N)
20	15	33	0.030000	0.030000
21	16	33	0.570000	0.570000
22	17	33	0.440000	0.440000
23	18	33	0.040000	0.040000
24	19	33	0.880000	0.880000
25	20	33	0.030000	0.030000
26	21	33	0.120000	0.120000
27	22	33	0.040000	0.040000
28	23	33	0.690000	0.690000
29	24	33	0.350000	0.350000
30	25	33	0.002000	0.002000
31	26	33	2.150000	2.150000
32	27	33	0.010000	0.010000
33	28	33	1.110000	1.110000
34	29	33	5.600000	5.600000
35	30	33	8.970000	8.970000
36	32	33	0.178000	0.178000
37	31	33	0.348000	0.348000

NO.	N	M	EPS(N,M)	EPS(M,N)
1	1	33	1.000000	1.000000
2	2	33	1.000000	1.000000
3	4	5	1.000000	1.000000
4	5	33	1.000000	1.000000
5	6	7	1.000000	1.000000
6	7	33	1.000000	1.000000
7	8	33	1.000000	1.000000
8	9	33	1.000000	1.000000
9	10	33	1.000000	1.000000
10	11	33	1.000000	1.000000
11	4	33	1.000000	1.000000
12	6	33	1.000000	1.000000
13	2	3	1.000000	1.000000
14	2	4	1.000000	1.000000
15	2	6	1.000000	1.000000
16	2	8	1.000000	1.000000
17	12	33	1.000000	1.000000
18	13	33	1.000000	1.000000
19	14	33	1.000000	1.000000

NO.	N	M	EPS(N,M)	EPS(M,N)
20	15	33	1.000000	1.000000
21	16	33	1.000000	1.000000
22	17	33	1.000000	1.000000
23	18	33	1.000000	1.000000
24	19	33	1.000000	1.000000
25	20	33	1.000000	1.000000
26	21	33	1.000000	1.000000
27	22	33	1.000000	1.000000
28	23	33	1.000000	1.000000
29	24	33	1.000000	1.000000
30	25	33	1.000000	1.000000
31	26	33	1.000000	1.000000
32	27	33	1.000000	1.000000
33	28	33	1.000000	1.000000
34	29	33	1.000000	1.000000
35	30	33	1.000000	1.000000
36	32	33	1.000000	1.000000
37	31	32	1.000000	1.000000